



RGB LIGHTING

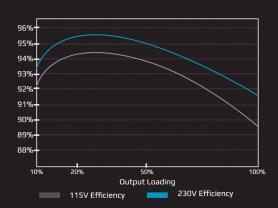
Access 16.8 million colors and three LED modes with P7-S1 (Project7-Software1), available with our P7-Hub (P7-H1). RGB





EFFICIENCY

80 PLUS Platinum certified for highest efficiency: Under typical load, efficiency is at 92% when 115VAC and efficiency is around 94%





This badge is granted to units with efficiency rates of

MODULAR CABLE OUTLETS



The fully modular and soft black flat cables make cable management convenient and deliver an easier

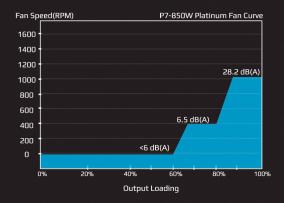
RealHardTechX GOLD AWARD



мегаобзор P7-850W

SOUNDLESS OPERATION

The fan kicks in at 60% load ensuring most of the time you won't





Certified by Cybenetics with the badge LAMBDA-A++. This badge is granted to units with average noise measurements of under 20 dB.

Available in

P7-650W P7-750W P7-850W

www.aerocool.us

Authorized **Dealers**





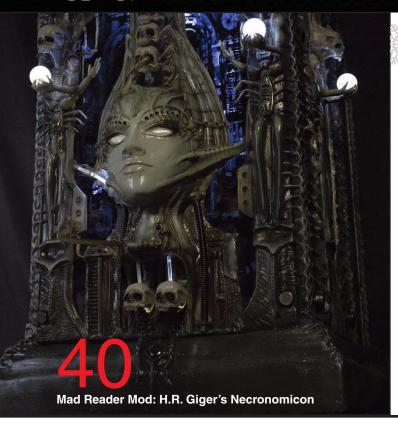








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'Tis the season! Here are two dozen items your power user would love to find under the tree this holiday.

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Monthly last-page interview with people who help to shape the PC industry.

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Gotcha. Here it is.

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GIGABYTE Targets SFF Builders With Mini-ITX Z370N WIFI Motherboard

GIGABYTE has a new Mini-ITX motherboard that comes with an LGA1151 socket and Intel's Z370 chipset. The small board measures just 170mm x 170mm, but still supports the latest Intel 8th Generation Core processors as well as up to 32GB of DDR4 at frequencies as high as 4,400MHz (O.C.) in its two DIMM slots. As its name suggests, the Z370N WIFI also is ready for wireless connectivity, as it supports Wi-Fi 802.11 a/b/g/n/ac, including support for 2.4/5GHz Dual-Band. The motherboard also has two Intel GbE LAN chips for fast wired connections. For expansion, the Z370N WIFI has one PCIe x16 slot. The board also has two M.2 connectors (one on the back side of the board) and four SATA 6Gbps connectors, and it supports RAID 0, 1, 5, and 10. The new GIGABYTE Z370N WIFI motherboard is available at retailers now for around \$160.

CORSAIR Releases HS50 Headset

CORSAIR has a new gaming headset out in time for the holiday buying season. The new HS50 Stereo Gaming Headset features plush over-the-ear cans and a Discordcertified detachable microphone. The HS50 is contructed of aluminum and is available in black with three accent color options: black, blue, and green. The accent coloring is very subtle and appears in a ring on each can and in a stitching pattern that appears on the headband. The sound is produced by 50mm neodymium drivers that CORSAIR says are "specially tuned" to create high-quality, accurate audio. The memory foam earcups and the wide headband are designed to provide comfort during long-term gaming sessions. The HS50 uses a universal 3.5mm connector for console and mobile gamers and the headset comes with a Y-cable adapter for use on a PC. MSRP for the gaming headset is \$49.99. The HS50 can be purchased directly from the CORSAIR website as well as from various retailers.



WATCHING THE CHIPS FALL

Hana ta Maa mutatu n	СРИ	Released	Original Price	Last Month's Price	Online Retail Price*
Here is the pricing	AMD Ryzen Threadripper 1950X (Zen)	8/10/2017	\$999.99	\$999.99	\$799.99
information for	AMD Ryzen Threadripper 1920X (Zen)	8/10/2017	\$799.99	\$779.99	\$649.99
various AMD and	AMD Ryzen 7 1800X (Zen)	3/2/2017	\$499	\$439.99	\$319.99
Intel CPUs.	AMD Ryzen 7 1700X (Zen)	3/2/2017	\$399	\$299.99	\$279.99
111161 6703.	AMD Ryzen 7 1700 (Zen)	3/2/2017	\$329	\$299.99	\$269.99
	AMD Ryzen 5 1600X (Zen)	4/11/2017	\$249	\$239.99	\$199.99
	AMD Ryzen 5 1600 (Zen)	4/11/2017	\$219.99	\$214.99	\$189.99
	AMD Ryzen 5 1500X (Zen)	4/11/2017	\$189	\$169.99	\$164.99
	AMD Ryzen 5 1400 (Zen)	4/11/2017	\$169	\$149.99	\$164.99
	AMD A10-7890K (Godavari)	3/1/2016	\$164.99	\$140.50	\$143.13
	Intel Core i9-7980XE (Skylake-X)	9/25/2017	\$1,999	\$2,099.99	\$1,999
	Intel Core i7-6950X (Broadwell-E)	5/31/2016	\$1,723**	\$1,577.89	\$1,759.40
	Intel Core i7-7940X (Skylake-X)	9/25/2017	\$1,399**	\$1,469.99	\$1,401.37
	Intel Core i9-7900X (Skylake-X)	6/26/2017	\$999.99**	\$969.99	\$969.99
	Intel Core i7-7820X (Skylake-X)	6/26/2017	\$599.99**	\$599.99	\$599.99
	Intel Core i7-7800X (Skylake-X)	6/26/2017	\$389.99**	\$379.99	\$379.99
As of November 2017	Intel Core i7-8700K (Coffee Lake)	10/5/2017	\$359**	\$389.99	\$414.99
** Manufacturer's	Intel Core i7-7700K (Kaby Lake)	1/3/2017	\$350**	\$339.99	\$289.99
estimated price	Intel Core i5-8600K (Coffee Lake)	10/5/2017	\$257**	\$279.99	\$299.99
per 1,000	Intel Core i3-8350K (Coffee Lake)	10/5/2017	\$168**	\$179.99	\$189.99

WHAT'S HAPPENING

HARDWARE



Razer Expands Its Mobile Gaming Reach With The New Razer Phone

Razer already makes notebooks aimed at gamers, but the company is going after a larger mobile market with the launch of its first phone. The new device runs on Android Nougat and is called . . . Razer Phone. The phone is clearly focused on entertainment, as Razer loaded it with high-end hardware for better audio and video. The device is powered by a Qualcomm Snapdragon 835 processor and 8GB of memory. The 5.72-inch display is Quad HD and a technology called UltraMotion syncs it with the GPU to automatically adjust the refresh rate up to 120Hz. Dolby Atmos technology powers the audio, and the USB-C audio adapter and 24-bit DAC are THX-certified. Other goodies include dual 12MP cameras with lenses that focus from f1.7 wide angle to 2X telephoto. Razer Game Booster software lets users maximize gaming performance, and a big 4,000mAh battery provides extended gametime. MSRP for the Razer Phone is \$699.99.

EKWB Launches Modular "Pick Your Parts" Cooling Loop Lineup

EK Water Blocks announced a new line of cooling products called MLC Phoenix that lets users pick and choose the components for an AIO cooling loop kit. You select from a lengthy lineup of radiators, full-cover GPU waterblocks, and CPU waterblocks. The radiators come with pumps and fans. The MLC parts list is extensive, so you can find waterblocks for particular makes and models of graphics cards and CPU sockets. All parts are prefilled with liquid and have QDC (quick disconnect) connectors, so in essence you can build an AIO kit that's perfectly matched for the components in your system. If you want to expand your system later on to include more graphics cards or larger radiators, you simply order the parts you need and swap them in/out. The QDC connections make it easy to adjust your loop at any time. EKWB says most MLC blocks are available in two versions (Nickel Acetal or Nickel Plexi) with copper bases. EKWB is now accepting pre-orders for MLC Phoenix parts on its site.





FSP Loads Up On Tempered Glass Panels, RGB Lights For New CMT510

FSP has unveiled a new computer case called the CMT510. The roomy mid-tower chassis features lots of glass and lighting and is aimed at gamers and builders using high-end components. The CMT510 has full tempered-glass panels on both sides as well as the front that are 50% translucent. The dark panels go with an interior that is also dark, as FSP has covered all the surfaces of the case with a black coating. The company says the dark surfaces help accentuate the LED lighting in the four preinstalled 120mm RGB fans (three intake fans in front, and one exhaust fan in back). The spacious chassis can handle graphics cards up to 400mm long and CPU coolers up to 165mm tall. It also supports ATX motherboards. FSP says the front of the chassis can hold radiators up to 360mm. The MSRP for the new CMT510 is \$99.99.



Lian Li Announces Alpha Case Series

Lian Li has two new cases called the Alpha 330 and the Alpha 550 RGB. Both models feature a similar interior layout and lots of tempered glass. The 330 features two 4mm glass panels, one on the front and one on the left side. Behind the glass of the front panel is a decorative lattice-style grille. There's room up front to show off radiators up to 420mm, and a PSU shroud runs along the bottom of the chassis. The Alpha 550 RGB adds RGB fans and more glass to the mix. This case has four glass panels (front, top, and both sides). The lattice grille is found on both the front and top of this chassis, and the case comes with three of Lian Li's Bora 120mm RGB fans preinstalled in front, along with an additional RGB strip. As with the 330, the 550 RGB includes a PSU shroud. Both cases offer extensive cable management throughout the interior in keeping with Lian Li's "clean build" theme. The two new Alpha models are available in either white or black. The Alpha 330 carries an MSRP of \$109, while the Alpha 550 RGB has an MSRP of \$179.

HARDWARE MOLE



G.SKILL Trident Z Kit Sets Record

The battle over who has the world's fastest 32GB kit of dual-channel memory continues. G.SKILL is now claiming the crown, saying its latest DDR4 Trident Z kit of four 8GB modules has set a world record at 4,400MHz. The 32GB Trident Z kit achieved the record on an ASUS ROG MAXIMUS X HERO (WI-FI AC) motherboard that used an Intel Core i7-8700 processor. The timings for the memory were CL19-19-19-39 at 1.5V. G.SKILL says each of its new Trident Z modules rely on Samsung B-die DDR4 IC chips that are "rigorously tested and binned" to ensure they meet the highest standards. The new kits support Intel's XMP 2.0 profile for fast overclocking, but G.SKILL says they also are ready for overclockers who want to manually tweak all settings. G.SKILL has not yet announced pricing or availability for the new kits.

Get Ready For Faster Data Transfers

PCI-SIG, the group that guides the evolution of the PCI bus expansion standard, has officially released the specifications for PCIe 4.0, version 1.0. The new standard provides for 16GTps data rates, effectively doubling the speed over PCIe 3.0. The increase in bandwidth opens the door for faster devices and greater connectivity options, as fewer PCIe lanes will be needed in some operations. The release announcement for the new standard was made in a blog post by PCI-SIG President Al Yanes and comes nearly seven years after the official release of PCIe 3.0. Yanes said there are other improvements provided by the new standard as well, such as reduced system latency and better I/O virtualization. Power users also will be pleased by something else Yanes mentioned in his post: Work continues on the PCIe 5.0 specification (32GTps), which the group is targeting for release in Q2 of 2019.





Up, Up & Away For Digital Currency, As Bitcoin Price Surges Over \$9,000

There's a story often told about how the first Bitcoin purchase online involved someone buying a pizza for 10,000 coins; years later those Bitcoins would be worth a few million dollars. Take a big gulp: that same amount of Bitcoin on Nov. 27 would have been worth more than \$97 million. That's right: the price of a single Bitcoin leapt past the \$9,000 threshold the weekend after Black Friday, and it was heading toward \$10,000 as we went to press. The news about excellent online sales at the traditional start of the holiday shopping period was one explanation pundits were giving for the big price jump, but Bitcoin in general has increased rapidly in value during 2017. At the start of the year, Bitcoin was valued at about \$1,000. There's no telling whether the trend will continue, and some people think all digital currencies are currently caught in a speculative bubble. So caveat emptor if you're thinking of buying (but if you do buy and make a gazillion dollars, remember your friends at CPU).

Mozilla Releases Quantum, The Brand-New Browser AKA Firefox 57

Mozilla has released Quantum, the browser also known as Firefox version 57. Quantum represents a major reworking of Firefox (the folks at Mozilla even refer to it as "the new Firefox), and it took a full year to finish the project. Mozilla says more than 4.8 million lines of code were added to the new version while it was being developed and more than 6.8 million other lines were changed. More than 700 people provided code for Quantum. During testing, programmers fixed 1,190 software bugs that affected user experience and 369 that affected performance. The end result is a browser that now runs about twice as fast as the previous version. Quantum also is more efficient. Mozilla says its tests show the new browser uses fewer resources than other popular browsers (for example, about 1/3 as much RAM as Chrome). See www.mozilla.org for details and to download Quantum.



SOFTWARE SHORTS



'Tis The Season For Giving; Now There's An App That Makes It Easier

A new mobile payment app called "CoinUp" aims to do some good in the world and make a profit at the same time. The app works with your current credit or debit cards as well as with mobile apps such as Venmo and PayPal. When you make a purchase, the app will round up the amount to the nearest dollar, and then it uses bank-approved encryption to pay the "virtual change" to the charitable cause that you designate. You can track how your extra change adds up over the month in the app's dashboard, and you can switch your target charity monthly or stop making donations at any time. CoinApp makes its money by taking a small amount (15%) off your donations, which the company says is less than the average processing fee for fundraising. You can learn more at www.coinupapp.com.

INTERNET



Season Is Green For Online Retailers

A recent Gallup survey of American adults that asked about their holiday shopping plans bodes well for online retailers. The survey asked more than 1,000 people which retail channels (department stores, discount stores, specialty stores, mail-order catalogs, and online shopping) they were planning to use during the 2017 holiday season. While department stores were mentioned most often (by 72% of survey participants), that was down from 74% in 2013. Online shopping tied with discount stores for second place with 65%, while specialty stores were at 52%. Mailorder catalogs were in last place with 22%. The results showed all channels have declined in recent years, with one glaring exception: online shopping. In fact, online shopping is the only retail channel that has increased in each of the periodic holiday shopping polls Gallup has taken since 1998, rising more than sixfold from 10% that year. If current trends continue, online shopping may become more popular than department store shopping by the 2019 holiday shopping season.

Trive Is A Browser Plug-In That Wants To Help You Spot Fake News

"Fake news" and "digital currency" seem to be two of the hottest topics in the news recently. Now there's a startup whose business model depends on both subjects. Trive is a company with an eponymous browser add-in that calls itself a "social science consensus engine." The company plans to use the wisdom of the crowds, combined with a blockchainbased rewards system, to help users discern what's real and fake online. The company has created a research and verification process that pays people to identify "fake" vs. "real" information. It uses this data to prevent fake news from leading you astray. Trive says the cost to users to avoid fake news stories will be about \$1/month, and there's also the opportunity to earn money as part of the verification ecosystem. Whether the concept will work or not is anyone's guess, but you can research the ideas behind the business model at www.trive.news.



hetwire Hotels Cars Flights Vacations 12/31/2017 12/01/2017 1 Rooms, 2 Adults, 0 Children

Hotwire's Seasonal Promotion Will Help You Get Away For The Holidays

Hotwire, the discount travel site that is a subsidiary of travel giant Expedia, is offering folks on a budget who are weary of holiday revelry the chance to get away for some R&R in the sleeply little town of . . . Las Vegas. The company is running a special "Million Dollar Sale" that offers travelers the chance to stay in 5-star Las Vegas hotels from Dec. 8 - 28 for only \$50/night. According to Hotwire, the average retail rate during the month for rooms at 5-star resorts in Las Vegas is \$432, which means vacationers who book now could save more than \$350 each day during their stay. Hotwire pays the difference in room price, until the \$1 million is gone or the promotion is over. (One note: Vegas hotel rates fluctuate wildly during the year, so whether you would have paid the full retail price to begin with is unknown.)

SITE SEEING



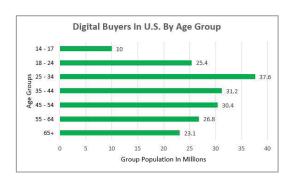
Job Of The Month

Halo, Destiny, Myth . . . some of the gaming industry's best-known titles sprang from the hearts and minds of the folks at Bungie. The company has been making gaming fun for more than a quarter-century, and it's looking for a new Associate Gameplay Engineer to join the team in Bellevue, WA. The person in this position works with creative talent to bring alien worlds and creatures to life in gaming storylines. You must be a math nerd and have a four-year degree in Comp Sci, Applied Maths, or a similar area. You should speak fluent C/C++ as you'll be writing and maintaining code in a production environment. The more you know about gaming and graphics algorithms, shaders, DirectX, and the like, the better. If you have any experience writing high-level simulations (physics, molecular, and so on) or if you have some skills with C##, that's a plus. Bungie wants sharp, fun, energetic people who enjoy working on teams that build new technologies. If that sounds like you, check out the job specifics at the site below.

Source: careers.bungie.com

Millennials Buy Stuff Online, Duh.

eMarketer's "U.S. Ecommerce
Performance Statpack 2017" is a
compilation of research on what
Americans are doing on the Internet.
As part of its study, eMarketer looked
at a group it calls Digital Buyers.
These are people who have made
at least one online purchase using a
smartphone, tablet, or computer during



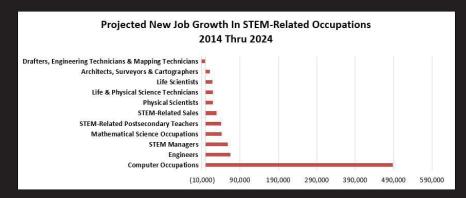
the current year. eMarketer found that older millennials (ages 25 to 34) are the age bracket with the most online purchasers. When combined with their younger brethren, the total number of millennials (ages 18 to 34) who have made online purchases in the past year is 63 million. This surpasses the 61.6 million total Generation X'ers (35 - 54) and 49.9 million Baby Boomers and older (55+) who are digital buyers.

Source: eMarketer.com

Want A Job? One Word: Computers

Earlier this year, the U.S. Department of Labor published a "Spotlight On Labor Statistics" that focused on projections for STEM occupations. No one knows what the job market will look like in 50 years, but in the near term, one thing seems clear: study computer-related topics and the future is bright.

Source: Bureal Of Labor Statistics, U.S. Dept. Of Labor





0

The number of monthly computing publications dedicated to computer power users, modders, and computing enthusiasts, that will exist starting in 2018.

Rumor Mill

2001

One plus the number of pounds that exist in one ton of hard drives; alternatively, the number of pounds that exist in one tonne of hard drives, minus 203.6. Also the year *CPU* magazine made its debut on newsstands nationwide.

Math Teachers & Magazine Historians

80 billion gazillion

The number of times a product delay, shipping error, or component failure caused Nathan and Andrew to run benchmark tests late at night or on weekends, or caused Vince and Chris to finish writing or editing an article just before deadline. Also equivalent to the number of miles Matt traveled on trade show floors plus the number of times Ron had to ask whether some term should be capitalized.

A Broken Calculator

Infinite

The amount of gratitude and good wishes we will always have for our readers, our advertisers, and everyone who ever earmarked a page in our magazine or bookmarked an article at our website, www.computerpoweruser.com.

CPU Staff (See page 86 for more info.)

10 Build, Or Not To Build

AVADirect's Shannon Robb On The Benefits Of Buying vs. Building

: Hey, Shannon, it's been a while! AVADirect recently moved to a new HQ, correct? How are you guys liking the new digs?

A It's really an awesome opportunity to stretch our legs a bit and start doing some new projects. This new facility truly can handle the workload that we have; it's three times the size of our old facility, possibly four, and it's awesome to see after being at AVADirect for only a year that we are already accomplishing some longterm goals we had for the direction of the company and what we wanted to accomplish.

: You've been on both the DIY and pre-built PC sides of the business now. Given that perspective, what would you say is the single biggest benefit of buying a prebuilt system vs. building your own DIY rig?

A.I would say the ease it adds to the process. Simply put, if you build a PC yourself, you must allocate the parts and you must test them and run the risk of whether they work or not. Then let's say a part is bad. You have to deal with RMA and replacement or having more parts on hand to test. AVADirect does all of that so that you get a PC that starts the first time, every time. And let's say down the road a part fails; we have free lifetime technical support, which means we are always here to help you

if you have issues with your PC. And if the issue is not easily remedied under standard troubleshooting, you just ship it in under warranty, and we help to get it up and going again.

: Is it fair to say that people often underestimate the value of getting tech support and warranty service when weighing the option to purchase a PC?

A Yes, I would say that's a more than fair statement. Many simply see the final cost, which they then compare to cost of the parts alone, and they do not account or even measure what their time is worth. Time testing, time building, time troubleshootingall of this can be measured, and I believe if more took that into consideration it would make sense.

: What kind of service does AVADirect offer for warranty repairs?

A AVADirect offers full warranty support including replacing every part needed to get your system running as well as it did the day we shipped it. If any part fails, we do not waste time, we simply replace it to ensure the best performance from your system. Also, even if out of warranty, we offer repair services with a very small fee for labor to get your system up and running or even upgraded if you choose at that point.

: What exactly comes with AVADirect's Lifetime Technical Support?

A AVADirect offers all customers lifetime troubleshooting and technical support. This is via live chat, email, or phone. We are all in the same facility, so you know you're getting someone who is directly connected to our team and ready to help if you have issues with your PC, even beyond your warranty period. Lifetime truly means lifetime—if you have an issue or question, we are here to support you and help troubleshoot or clarify specific things as needed.

: What other kinds of things do people tend to take for granted or not even think of when considering buying vs. building that makes a pre-built system a good idea?

A. This kind of touches on what I said before. I think the biggest thing is that you can plug in and go without it being a generic, off-the-shelf build. Time is number one to me . . . that and cable management, which is the bane of my existence on my own builds as I get to the end and want to see it run. Trying to manage all of the cables is enough to drive me insane, and I'm quite sure that I am not the only one on this.

: One of the things that we've heard from lots of DIY guys is that they don't like getting systems packed with a bunch of software they didn't install and don't want, and having their systems bark at them

Advertisement



trying to get them to register and pay for free trial software. What's AVADirect's stance on pre-loading stuff like that onto systems you sell?

A It can be summed up in one word—NEVER. AVADirect believes that all users deserve as clean of an OS as possible with as little bloat as possible. We even avoid installing some of the bloated apps that come with hardware if not necessary, giving that option to the user (we send all included software discs/manuals with the system) so that they get a cleanrunning machine without resourcewasting or annoying apps that will just slow down their rig or have potential annoying pop-ups.

extensive personalization options, as well, right? So guys who want to avoid a plain-Jane, stock-looking PC don't need to worry about that? Can you talk about

the kinds of custom work customers can order from AVADirect?

A This is a tough one to define as we have gone as far as cutting cases to fit things, custom paint jobs, custom hard-tube liquid cooling, and even custom-soldered LED strips to exactly fit your build. I had a phrase I used recently which was "You Dream It, We Build It." I think that's a fair statement as to how we feel about custom builds. We are willing to consider anything a customer would like.

: What kind of options are available for overclocking and custom cooling?

Now you're talking my language!

If you remember last year when we spoke, this was one of the sole things I had come here for, and while my role has changed significantly, I am still deeply involved in this. As

you can see, we go a little nuts with our hard-tube bends because to us, sticking together straight runs of tubes may be good for consistency, but it lacks the artistry you get with custom hand-bent tubes. We don't have preset jigs or anything of the sort. Every system is 100% hand-built. For overclocking, we have two levels: Mild and Extreme. Ryzen gets Mild, as we all know now the overclocking is limited and we simply do not have much left on the table from our friends at AMD for these chips. But we

always push for as much performance as possible when customers request overclocks.

: Does AVADirect have any customers who used to be hard-core DIY guys, and if so, what brought them around?

We have had many customers A who have stated they used to build all their own systems, but the time investment for them simply didn't pan out anymore and they wanted something that just showed up and worked. That's not to say this applies to every case, as everyone has different needs or wants. But as we grow and show what we can do more and more, I believe everyone will see that we will build it the same way they would, and with the same level of care and attention to detail, but with the added benefit of experience from a host of previous builds.

Lar Canc Gaming Headset Roundup

When shopping for a PC gaming headset, many gamers—unable to try out multiple headsets before making a purchase—simply opt for a known brand. That's all well and good if your biggest priorities have more to do with RGB LEDs, driver diameters, and accent colors. If you're more concerned with a headset's comfort level, sound reproduction capabilities, and convenience features, then we're here to bridge the gap between what's listed in the device's specs sheet and what you'll actually experience when you put the headset on and hit play or start gaming. Now's a great time to start pampering your ears.

Astro A40 TR & MixAmp Pro TR

ASTRO's headset is in the same budget-crushing neighborhood as the Sennheiser PC 3783D, but there's some added value here that you just won't get with any other headset in this roundup.

Regarding build materials, the A40 TR (Tournament Ready) consists of a split plastic headband with a removable padded insert slotted in the middle. The cans pivot on black plastic frames, which are connected to the headband via aluminum cylinders. Headset adjustments can be made via sliding either side (or both), making the A40 a perfect fit for virtually anyone. The headset ships with a pair of soft, breathable fabric can cushions and the headband pad is made of the same material. ASTRO was kind enough to send us a green Mod Kit (\$59.99), which swaps the can and headband cushions for noise-isolating leatherette pads and includes a pair of closedback Speaker Tags and a voice-isolating mic. They add a nice splash of color, but Astro's Mod Kits are an expensive addition to an already pricey audio setup.



A40 TR & MixAmp Pro TR

\$249.99 | Astro | www.astrogaming.com

Specs: Drivers: 40mm, 20Hz to 24kHz; Impedance: 48 ohm @ 1kHz; Mic: voice-isolating; Controller: In-line mic mute; LEDs: None; Connector: 4-pole 3.5mm plug; MixAmp Pro: Volume dial, Game/Voice mixer; Ports: Optical Audio in, Stream port in, USB in, 2 daisy chain outs, 4-pole auxiliary out, 4-pole headphone out

Although it's not a feature everyone will use, we like that you can move the mic to the other can. Removing the Speaker Tags effectively makes this headset an open-back design, which lets in a decent amount of exterior sound. The comfort level of the A40 was as good as any other headset we tested, even though the ear cushions are wide enough that they rest on your ears. Weighing in at 12 ounces, the A40 is one of the heavier headsets we tested, which may become a factor after a few hours of extended use.

The ASTRO A40 is solid compared to the best performers in this roundup when it comes to delivering a great listening experience. The MixAmp Pro (\$129.99), which supports a wider frequency response than the headset, is a must-have for those who enjoy a lot of multiplayer gaming. It lets you turn a volume dial to find the perfect mix between game sounds and voice chat, and adds push-button access to Dolby 7.1 surround effects and up to four customizable EQ presets. Streamers can also use the MixAmp Pro to take more control over what their audience hears. The ASTRO Command Center is also an easy-to-use and highly functional utility.



VOID PRO RGB Wireless

\$99.99 | Corsair | www.corsair.com

Specs: Drivers: 50mm neodymium, 20Hz to 20kHz, 7.1 Surround; Impedance: 32 ohm @ 1kHz; Mic: 100Hz to 10kHz; Sensitivity: -38dB (+/-3dB); Controller: On-can mute/power button; LEDs: RGB Corsair logo; Connector: 2.4GHz USB Receiver & Dock; Battery life: approx. 16 hrs.





IMMERSA PRO

\$89.99 | COUGAR | www.cougargaming.com

Specs: Drivers: 50mm neodymium, 20Hz to 20kHz, 7.1 surround; Impedance: 32 ohm (+/- 15%); Mic: Noise canceling, retractable, 100Hz to 16kHz; Sensitivity: -40dB (+/-3dB); Controller: on-can volume/mic mute; LEDs: RGB can lighting; Connector: USB, 4-pole 3.5mm plug adapter.

The ASTRO A40 is a little behind the HyperX Cloud Alpha and Razer Kraken 7.1 in terms of raw audio chops, but the MixAmp Pro bundle makes a compelling argument in its favor for multiplayer gamers and frequent streamers.

Corsair VOID PRO RGB Wireless

A few months ago, we reviewed the VOID PRO Surround, but for this roundup, we got in the similar-sounding, but significantly less tied-down VOID PRO RGB Wireless. This headset is a 2.4GHz wireless unit that features a built-in battery with an impressive 16-hour play time, 40 feet of wireless range, and an RGB LED under the Corsair logo on the cans.

Unlike the VOID PRO Surround, this model only works with the USB dongle, so you're limited to PC or laptop use. Dolby Headphone 7.1 surround sound is supported, and you can tap into the CUE (Corsair Utility Engine) software to cycle between virtual 7.1 or 5.1 surround sound output, or switch to stereo output, regardless of whether you're listening to music, watching streaming video, or playing games.

This headset features custom-tuned 50mm neodymium magnet drivers, which delivered a rich and full sound experience regardless of what we were listening to. The unidirectional noisecancelling microphone on this unit delivers a similar high-quality experience, with its wide 50Hz to 18kHz frequency response and-38dB (+/-3dB) sensitivity. The VOID PRO RGB Wireless also supports Sidetone Control, which lets you hear your voice through the headphones to keep you from shouting unnecessarily, becoming the heavy breather, or obliviously munching chips into the mic. [ED NOTE: What are you trying to say, Andrew?]

The unit is composed of a plastic adjustable headband, with anodized black aluminum brackets between the headband and the cans, letting them swivel and rotate for a perfect fit or easy travel. Despite the necessity of a battery,

the headset feels remarkably balanced and light. Like The Logitech G933 Artemis Spectrum, the VOID PRO RGB Wireless also has a battery-conserving automatic shutdown feature, which engages after 10 minutes of inactivity.

The VOID PRO RGB Wireless, like the previous VOID PRO we tested, is one of the more comfortable headsets we've used. Despite the presence of a sizeable battery, the headset's weight is evenly distributed across the microfiber mesh headband and soft mesh-covered memory foam can cushions. Those cushions are also large enough that they're not resting on any sensitive portions of your ears. As a result, the headset stays put and feels great, even after hours of nonstop gaming.

With this headset, Corsair set out to take everything we love about the VOID PRO and make it wireless. The end result is a headset that affords more freedom of movement, without making compromises in sound quality.

COUGAR IMMERSA PRO 7.1

The COUGAR IMMERSA PRO is a headset that has some unique features that make it stand out. It's a 7.1 surround sound-capable headset that relies on a USB connector for use on a PC or laptop, but also comes with a 4-pole 3.5mm adapter, which lets you use it on consoles, phones, and more.

The unique look of the headset is highlighted by a pair of flexible orange rods that make up the headband frame. There's a pleather-covered pad that spans the rods to provide a little support at the top of your head, but the real reason this headset sits so firmly where you want is down to the stiff rods and thick ear cushions. These pads are large and round, but the inner portion that rests against your ears is ovalshaped. The foam under the pleather cushion covers is considerably stiffer than that of the Razer and HyperX headsets, so the IMMERSA PRO's comfort factor, while decent, just wasn't in the same league. The headset was one of the lighter models we tested, which





Cloud Alpha

\$99.99 | HyperX | www.hyperxgaming.com

Specs: Drivers: 50mm dual-chamber neodymium magnet, 13Hz to 27kHz, Stereo; Impedance: 65 ohms @ 1kHz; Mic: Electret condenser microphone; Noise canceling, detachable, 50Hz to 18kHz; Sensitivity: -43dBV (+/-3dB); Controller: In-line volume/mic mute; LEDs: None; Connector: 3.5mm 4-pole plug plus separate 3.5mm mic & line out Y-adapter

Hands down, the Cloud Alpha from HyperX was our favorite headset of the bunch.

works in its favor during extended gaming sessions.

The headset has a pair of knurled aluminum dials on each can; the dial on the right can controls the volume and the one on the left mutes and unmutes the mic, with an LED indicator to show you the current setting at a glance. The mic on the IMMERSA PRO is very similar to that of Razer's Kraken 7.1

V2; however, the boom isn't flexible enough to let you make adjustments to the mic's distance from your mouth. We recommend just retracting it when you don't need to talk with your teammates.

The sound quality with the IMMERSA PRO was decidedly middle-of-theroad compared to many of the headsets here. The 50mm drivers were capable of pushing out some powerful audio, but their frequency response range was disappointingly narrow considering the IMMERSA PRO's price point.

The aggressive styling and versatility are the two strongest features of the IMMERSA PRO, but sound quality and comfort appear to have been lesser priorities for COUGAR.

Kingston HyperX Cloud Alpha

We've not been shy about our fondness for Kingston's HyperX-branded Cloud headsets. The Cloud II is still a mainstay of our personal gaming setup due to its solid sound performance and comfortable fit. The Cloud Stinger shed some extra weight and dropped the price, but still offers a great-sounding experience and a high degree of comfort. In the Cloud Alpha, we're getting a substantial upgrade in both categories.

But let's get the style part out of the way first. The headset is composed of black plastic with a matte finish that feels rubberized to the touch. The back of each can is an aluminum disk, and the hinged fork that holds the headband to the cans is a thick bent piece of red anodized aluminum. The black headband is thickly padded and highlighted on the edges with red stitching. The Cloud Alpha's ear pads and headband pad are covered with a pleather material that's just as soft as that of the Razer Kraken 7.1 V2. The ear pad foam is definitely on the softer side, as well, making this headset very comfortable to wear for extended periods. Gamers who wear glasses will also likely favor this headset's light touch.

The lone neodymium magnet driver inside each can is 50mm in diameter, but Kingston has engineered a dual-chamber design that allows the mid-range and high-end frequencies to reverberate separately from the low-frequency sound waves. In practice, this feature manifests as a more nuanced audio experience, whether we were playing games, listening to music or streaming video. The wide frequency response of these drivers also hammers home this headset's premium listening experience.



G933 Artemis Spectrum Snow

\$199.99 | Logitech | www.logitech.com

Specs: Drivers: 40mm, 20Hz to 20kHz, 7.1 surround; Impedance: 39 ohms @ 1kHz (passive), 5k ohms (active); Mic: 4mm Cardioid (Unidirectional), noise canceling, retractable, extendable, 100Hz to 20kHz; Controller: In-line volume/mic mute; 3 programmable G-Keys; LEDs: RGB, two zones; Connector: 2.4GHz wireless, 3.5mm analog, RCA to 3.5mm cable, USB data/charging cable, USB powered wireless mix adapter; Battery Life: 8hrs. (default lighting)/12hrs. (no lighting)



Viper V370 7.1 Virtual Surround Gaming Headset \$69.99 | Patriot | www.patriotmemory.com

Specs: Drivers: 40mm neodymium main, 30mm sub, 20Hz to 20kHz, 7.1 surround; Impedance: 32 ohm @ 1kHz; Sensitivity 110db +/- 3dB @ 1kHz; Mic: non-detachable omnidirectional, Frequency response: 100Hz to 10kHz; Sensitivity: -46dB +/- 3dB; Controller: on-can volume, UBR switch; Connector: USB

Extras like a detachable mic with a highly flexible boom, in-line volume dial and mute switch, and braided black nylon cords make this a stereo headset feel as first-rate as it sounds. Hands down, this headset was our favorite of the bunch.

Logitech G933 **Artemis Spectrum Snow**

Logitech has been a mainstay of gaming headsets long enough that we shouldn't be surprised to find its G933 Artemis Spectrum to be one of the most feature-rich headsets available. There are three versions of the Artemis Spectrum; we tested the white "Snow" edition. This was one of two wireless headsets in this roundup, but we experienced zero lag or latency resulting from either headset's lack of wires. This headset uses a 2.4GHz radio, and there was no perceptible difference when using this headset with and without the wires (yes, you have the option). Battery life is a solid eight hours with the RGB LED effects on, and 12 hours with the LEDs off. The LEDs generally look good, but we noticed that red looks decidedly pink when filtered through the frosted-plastic G logo.

The headset is composed primarily of plastic. We like the look and feel of the chromed gray forks, but they are fingerprint magnets. The headset can cushions are removable, washable, and designed to fully envelop your ears without applying pressure to any portion of the lobes. Although this makes the G933 comfortable for extended use, we do wish the fabric Logitech chose was a little softer to the touch.

The left can features a number of buttons and dials, for controlling volume, turning the headset on and off, and launching one of three G-Keybased shortcuts. The mic boom folds down from the left can and a flexible tip extends. There's an LED on the mic to indicate the mute status, and it mutes automatically when tucked

away. The headset folds flat and the wireless USB dongle nests inside one of the can flaps, making the G933 easy to travel with. This headset is also one of the heavier units we tested, though this didn't really cause a problem for us when gaming for extended periods.

Because you can use it wired or wirelessly, the G933 Artemis Spectrum works with PCs, laptops, and consoles. You can also charge the battery without missing a beat in your game, just by plugging in the mini USB charging cable. Conveniently, the headset will go into sleep mode after not receiving an audio signal for five minutes, making sure you don't sit down to game, only to find the headset battery drained; it'll take 3.5 hours to fully recharge.

Logitech's G933 Artemis Spectrum is definitely one of the more expensive headsets out there, and its sound quality, although stellar, is not in the same league as the Sennheiser, HyperX, or Razer headsets. That being said, however, the versatility, unique design, and comfortable fit of this headset make it a worthy choice for those intent on a wireless headset.

Patriot Viper V370 7.1 **Virtual Surround Gaming Headset**

We reviewed the Patriot Viper V370 headset earlier this year, but as we went to press, you could find it for significantly less than the headset's initial MSRP. The Viper V370 is a 7.1 virtual surround sound model that integrates a volume dial and UBR (Ultra Bass Response) switch into the left can. The unit also features an omnidirectional mic that folds inconspicuously into the headset when you don't need it. Compared to the original Viper headsets, this one relocates the Viper logo to the cans and incorporates an RGB LED light to frame it. This unit also has a wider adjustable headband. This headset has a matte-black finish that feels rubberized and silver and red accents that extend to the 7-foot braided nylon cord. Metalmesh grilles on each can also add to the headset's visual appeal.





Kraken 7.1 V2 \$99.99 | Razer | www.razerzone.com

Specs: Drivers: 50mm neodymium magnet, 12Hz to 28kHz, 7.1 surround; Impedance: 32 ohms @ 1kHz; Mic: Active noise canceling, retractable, 100Hz to 10kHz; Sensitivity: -38dB (+/-3dB); Controller: None; LEDs: RGB (Razer Chroma); Connector: USB

Previous versions of the Viper headset featured an onboard LED switch, but this one relies on Patriot's software utility. The headset features a closed-back design that blocks exterior environmental noise and a pair of 40mm neodymium magnet main drivers deliver a quality sound field in the mid-range and high-end frequencies. Each can also houses a 30mm sub-driver, which helps deliver some extra punch at the lower frequencies.

The headset features a rigid mic boom, leaving the mic a fair distance from the mouth. This resulted in some added environmental noise muddying our conversation, but our teammates reported that it didn't keep them from clearly understanding us in the heat of battle.

Patriot's Viper V370 is a solid choice for gamers looking for a comfortable virtual 7.1-capable headset that won't gut their wallets.

Razer Kraken 7.1 V2

When it comes to style, Razer always seems to have an edge on the competition. Compared to the rest of the headsets in this roundup, however, the Kraken 7.1 V2 almost comes off looking bland. The cans are composed of matte black plastic and black metal mesh, and the forked hinges and headband edges are black anodized aluminum. The ear cushions and the headband's top and sides are covered in a soft pleather material, but the underside of the headband is draped in a breathable mesh fabric. The mic boom extends and retracts into the left can, and you can mute and unmute the mic by softly pressing the tip; a red LED lights to indicate when the mic is muted. The mic boom is somewhat flexible, letting slightly you change its position when extended, but it is less flexible than we'd like.

The V2 in this headset's title refers to the new oval ear cushions, which do a better job of fitting over the sensitive parts of your ears for hours upon hours of comfortable use, even for users with glasses. Razer's logo on each can is RGB LED-backlit, and you can use the Synapse 2.0 software to tweak the colors and effects. For those new to Razer

peripherals, you'll need to create a Razerzone. com account and login to access this headset's more advanced features, such as the surround calibration and RGB lighting. None of the

in mind, as a USB-only unit, you won't be able to use it with a gaming console.

The Kraken 7.1 V2 falters when it comes to the software, but scores high





Nebula GX10 Stereo Gaming Headset

\$24.99 | Rosewill | www.rosewill.com

Specs: Drivers: 40mm, 20Hz to 20kHz, stereo; Input Impedance: 32 ohm @ 1kHz; Mic: Noise canceling, fixed, 50Hz to 10kHz; Sensitivity: -38dB (+/-3dB); Controller: In-line volume/mic mute; LEDs: blue; Connector: Separate 3.5mm plugs for mic & line out, USB for LED power; Y-cable adapter

other headsets had this cloud-based hurdle, and there was nothing in Synapse 2.0 that justified this superfluous login procedure.

Although you may be nonplussed at having to jump through such hoops to run the software, your ears are in for a treat. The drivers in this headset have one of the widest frequency responses of any headset we tested, and it really comes across when gaming and listening to music, movies, and TV shows; their raw audio performance was superior at every end of the spectrum. The 7.1 surround sound capabilities rely on an algorithm as opposed to discrete speakers in the cans, but it's still pretty convincing in suitable TV shows and movies. It may not give you a tactical advantage in games, but it's nice to have positional audio as an option. Keep marks in all the most important categories, including raw performance and long-lasting comfort.

Rosewill Nebula GX10 Stereo Gaming Headset

We took the entry-level Rosewill Nebula GX10 for a spin a couple of months ago, and came away impressed with both its performance and price point. This is a stereo headset with large over-the-ear cans. Each one is attached to the foam padded headband by a rigid doubled-up wire that lets each can slide independently to fit virtually any-sized melon. There's an N logo on the center of each can, but a large mesh circle lights up with diffuse blue light when you connect the optional USB plug. The cans are padded with a soft blue foam and covered in a pliable

faux leather. This helps keep the headset's considerable sound output between the drivers and your ears, where it belongs.

The mic is on a fixed beam that you can rotate up and out of the way, and minor adjustments can be made with the mildly flexible tip. The cord that runs to one of the more comfortable headsets of the lot. The overall build quality was also higher than we expected for an entry-level headset.

If you don't have a lot of cash to spend on a gaming headset, the Rosewill Nebula GX10 is an easy recommendation. The



PC 373D

\$249.99 | Sennheiser | en-us.sennheiser.com

Specs: Drivers: 40mm, 15Hz to 28kHz, 7.1 surround; Impedance: 50 ohm; Mic: Noise canceling, rotate up to mute, 50Hz to 16kHz; Sensitivity: -38dBV/PA; Controller: On-can volume: LEDs: None: Connector: USB

each can from the headband is covered in blue nylon, as is the thick cable that terminates with 3.5mm phono plugs. There are dedicated mic and line-out plugs for PC use, but the headset ships with a Y-adapter cable that makes it suitable for use with portable devices, game consoles, and laptops.

The sound field you'll enjoy with this headset is pretty respectable given the affordable sticker price of the Nebula GX10, with a wide mid-range, punchy bass, and an only slightly muted high end. Due to its lightweight construction, the Nebula GX10 was fact that it looks great—as long as you like blue LEDs—is just icing on the cake.

Sennheiser PC 373D

Sennheiser's PC 373D is a headset that'll lighten your wallet considerably more than the competition, but there are a few other things that make this headset stand out from the crowd, both for better and for worse.

Aesthetically, the PC 373D is rather muted compared to the other high-ticket headset, the Logitech G933 Artemis Spectrum Snow. It's constructed primarily of matte-black

plastic, but there's no rubberizedsensation to the finish like the HyperX Cloud Alpha's. The cans have large louvered vents on the sides, with a semicircular notch, which is designed to accommodate the mic boom on the left can and the volume dial on the right one. The only hint of color comes from a pair of red chrome bands on the mic boom, the red metal mesh on the front and back of the noise-cancelling microphone, and the inner lining of the cans. The ear cushions and headband pad consist of velvet-covered foam that's a bit stiffer to the touch than some of the other headsets featured here, however the PC 373D was also very light, making it one of the more comfortable to wear for a prolonged span of time.

Those louvers we mentioned aren't merely a visual flair, they represent this headset's open-can design, which lets in sound from your surrounding environment. The velvet-covered ear cushions also help exterior noise filter to your ears. Of all the headsets we tested, this is the only one we used that let us hear the clicking of our Cherry MX Blue keyboard switches while listening to music.

The PC 373D relies on a pair of 40mm transducers to deliver a rich and clear sound field. Compared to the Razer and HyperX offerings, however, the low-end frequencies had a little less punch. The USB connector features an in-line Dolby on/off switch, which lets you cycle between stereo and algorithmic 7.1 surround sound. The compulsory software utility lacks any bells and whistles, but if you don't bother "tweaking" EQ settings much, you'll appreciate the simplified interface.

The headset's build materials and overall construction feel too plasticky, which is disappointing considering the PC 373D's steep price. If you need a high-performance headset that doesn't completely cut you off from your surrounding environment, then the Sennheiser PC 373D is a sound choice.



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The MSI GTX 1070 Ti Gaming 8G Takes On ZOTAC's GTX 1070 Ti AMP! EXTREME

ay hello to one weird mutant of a graphics Card: the GTX 1070 Ti. The GP104 chip at the center of this graphics card is nothing new; it is manufactured using TSMC's 16nm FinFET process and comprises 7.2 billion dual-gate transistors. The GTX 1070 this card shares its name with features 15 SMs, and the GTX 1080 has 20. Rather than split the difference, NVIDIA left 19 SMs enabled on the 1070 Ti, giving it access to 2,432 CUDA cores, 152 texture units, and 64 render output units. There is an 8GB bank of onboard memory, and the GDDR5 chips are clocked at 8Gbps and running on a 256-bit bus. The base clock on this card is set to the GTX 1080's 1,607MHz, and the boost clock is set to the GTX 1070's 1,683MHz.

As if it were designed by a committee, this 180-watt hybrid comes with a suggested retail price halfway between the GTX 1070 and the 1080, at \$450. It's an enticing proposition on paper, but thanks to MSI and ZOTAC, we've got two samples in house to see how the GTX 1070 Ti really stacks up. Before we get into specifics, though, we need to discuss the clocks on the GTX 1070 Ti.

Clocking Questions

The gap between the vanilla 1070's base and boost clock is 177MHz. The 1080's gap is 126MHz. The difference between the two clocks on the 1070 Ti is a conspicuously puny 76MHz. NVIDIA is disallowing its partner card manufacturers from shipping 1070 Tis with factory overclocks, meaning every card you might want to compare has the same clocks. MSI, for instance, sells five versions of the 1070 Ti, costing between \$449 for the 1070 Ti AERO 8G and \$489 for the Gaming 8G. Power availability and the cooling capacity of the heatsink and shroud combos on third-party versions

of the 1070 Ti, evidenced by these two, is comparable to that of the GTX 1080. So what gives? To us, this looks like a blatant attempt by NVIDIA to avoid cannibalizing sales of the GTX 1080. But let's let the numbers speak for themselves.

ZOTAC GeForce GTX 1070 Ti AMP! EXTREME

When it comes to custom heatsinks, ZOTAC has not been shy about going big, and the 1070 Ti AMP Extreme is no exception. This card is 12.8-inches long, 2.5slots thick, and it extends more than an inch past the bracket. The card's shroud consists of ZOTAC's signature Carbon EXOARMOR, which blends a metallic slate-colored metal shroud with a glossy plastic fan frame that's reminiscent of carbon fiber. There's a painted metal backplate that wraps around the top and front edges of the heatsink to help contain heat. There are three dual-blade EKO FANS designed to minimize airflow dead spots. These are attached to the surface of ZOTAC's IceStorm cooler, which consists of copper heatpipes of varying diameters and a massive aluminum heatsink. SPECTRAenabled LEDs illuminate the face of the card,

as well as the ZOTAC logo on the top edge and the Push The Limit badge on the backplate.

On the custom PCB, you'll find an 8-phase VRM that spreads the power load and heat across more components for consistent performance and better long-term stability. The backplate also draws your attention to Power Boost IC, which is designed to reduce ripple noise and minimize the adverse effects of power fluctuations that can impact performance. To power this card, ZOTAC provides a pair of 8-pin PCIe power plugs and display output options include three DisplayPort 1.4 ports, one HDMI 2.0b port, and a dual link DVI-D port.

The FireStorm software utility lets you adjust the LEDs in three zones and manually overclock the card with easy-to-decipher controls for core clock, voltage, memory clock, power limits, and more. According to ZOTAC, the card has been factory tested to support a 150MHz higher core and 200MHz higher memory clock. To ease the overclocking process, and circumvent NVIDIA's absurd factory overclocking ban, ZOTAC bundles a custom overclocked profile with FireStorm, which raises the core to 1,833MHz.

In the benchmarks, the ZOTAC GTX 1070 Ti AMP Extreme performs well, if just shy of an overclocked GTX 1080. Due to this card's sticker price, however, it's hard to recommend this card when you can find GTX 1080s going for the same price.



GeForce GTX 1070 Ti AMP! Extreme \$499 | ZOTAC | www.zotac.com



CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

MSI GeForce GTX 1070 Ti Gaming 8G

MSI slaps its Twin Frozr VI heatsink onto every GPU it sells, so it's no surprise to see it on this GTX 1070 Ti. This card has a nice flat profile that's perfectly contained within its two-slot form factor for easy side-by-side SLI, but like ZOTAC's AMP Extreme card, it extends above the top edge of the bracket by about an inch. The shroud of the card consists of red and black plastic, with LED-backlit translucent red accents on the right side. The heatsink consists of large 8mm nickel-plated copper heatpipes threaded through a sizeable bank of aluminum fins. There's an anodized black aluminum backplate, and another plate of aluminum underneath the heatsink to help cool off memory chips and VRM-adjacent components. These plates form a PCB sandwich that adds rigidity to the card and improves overall cooling efficiency. There's an RGB LED-backlit MSI dragon logo on the top of the card that you can tweak using the MSI Mystic Light software utility. On the face of the card you'll find a pair of 95mm TORX 2.0 fans with alternating dispersion fan blades designed to accelerate airflow without increasing noise output. These are dual-ball bearing fans, which may be a tad noisier than sleeve-bearing fans, but these will likely run for longer. If noise is important to you, then you'll probably appreciate MSI's ZeroFrozr technology, which lets the fans stop spinning when the card's idle or running cooler than 60 degrees Celsius.

The PCB on MSI's card features a 10phase VRM and MSI's military-class components, including Hi-C capacitors, Super Ferrite chokes, and Japanese solid capacitors. Unlike every other MSI card

we've tested, however, there's no support for the MSI Gaming App, so any overclocking you do will need to be done in MSI's AfterBurner utility. Strangely, in the benchmarks this card boosted well beyond the measly 1,683MHz boost clock, and was bouncing between 1,850MHz and higher, depending on the workload.

Outputs include three full-sized DisplayPort 1.4, one full size HDMI 2.0b, and one DVI-D port. MSI's contender gets power via one 8-pin and one 6-pin PCIe power connector.

In the real-world games, MSI's card managed to outpace ZOTAC's, but the synthetic tests favored the AMP Extreme. This card shaves \$10 off the base price, but head-to-head, we're going to call this match a Ti[e]. If you find the GTX 1080 on sale, however, both of these cards get rather less compelling. ■

BY ANDREW LEIBMAN



GeForce GTX 1070 Ti Gaming 8G \$489 | MSI | www.msi.com



Specs & Scores	ZOTAC 1070 Ti AMP! EXT.	MSI 1070 Ti Gaming 8G
Base clock	1,607MHz	1,607MHz
Boost clock	1,833MHz (SW OC)	(Unlocked)
Memory clock	2,000MHz	2,002MHz
Memory	256-bit 8GB GDDR5	256-bit 8GB GDDR5
3DMark Fire Strike Ex	9,680	9,053
Graphics Score	10,019	9,328
Physics Score	26,645	26,407
Graphics Test 1	53.25fps	48.91fps
Graphics Test 2	39.86fps	34.65fps
Physics Test	84.59fps	83.83fps
Combined Test	20.39fps	19.09fps
Unigine Superposition	4,243	3,978
1080p Ex (Avg/Min/Max)	31.74/26.2/36.03	29.76/24.16/33.89
Games	1,920	x 1,080
HITMAN (DX12, Vsync Off, Ultra)	93.65fps	93.98fps
Metro: LL (DX11, V. High, 16XAF, V. High Tess.)	129.67fps	131.33fps
Sniper Elite 4 (DX12, Vsync Off, Ultra)	109.31fps	108.12fps
Witcher 3 (Vsync Off, Unl. FPS, Ultra)	142.47fps	137.09fps
	2,560	x 1,440
HITMAN (DX12, Vsync Off, Ultra)	85.97fps	85.21fps
Metro: LL (DX11, V. High, 16XAF, V. High Tess.)	89.33fps	91.33fps
Sniper Elite 4 (DX12, Vsync Off, Ultra)	72.59fps	74.54fps
Witcher 3 (Vsync Off, Unl. FPS, Ultra)	91.9fps	89.73fps
	3,840	x 2,160
HITMAN (DX12, Vsync Off, Ultra)	50.07fps	50.14fps
Metro: LL (DX11, V. High, 16XAF, V. High Tess.)	48.33fps	49.67fps
Sniper Elite 4 (DX12, Vsync Off, Ultra)	36.81fps	35.3fps
Witcher 3 (Vsync Off, Unl. FPS, Ultra)	46.6fps	50.9fps





Infinite A \$1,699.99 MSI us.msi.com

MSI Infinite A

PU has reviewed a few MSI desktop CPCs over the past few years, and although they had varied designs and hardware, a small form factor was one common thread. Going small is often a smart move for computer hardware manufacturers such as MSI, because it's often more challenging for gamers to put together their own small form factor rig than a system in a mid- or full-tower chassis that fits standard-sized components. The Infinite A, however, breaks away from many of MSI's previous efforts. It's a mid-tower with loads of LED lighting and a tempered glass side panel. The more traditional size, in theory, offers greater mass appeal for gamers who don't want to build their own rig and don't want a say over each-and-every part, like you often see with a PC boutique.

The Infinite A follows many of the latest PC design trends. Let's start with the LED lighting. The front panel boasts a printed circuit board pattern with customizable LED effects that run along an angular section near the side panel. Just fire up the MysticLight app and you'll be able to pick between Meteor, Pendulum, and Kaleidoscope effectsall of which are more visually appealing than the standard breathing or flashing modes so common on RGB components. You can also customize the look of the motherboard and GPU lighting with MSI's Gaming app. The overall LED lighting effects are pleasant, without being garish, and complement the brushed aluminum and tempered glass elements of the chassis.

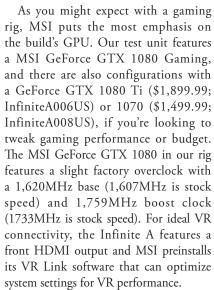
MSI includes both the tempered glass side panel and a solid steel panel, but we imagine most enthusiasts will opt for the dark tempered glass. Besides looking classy, the dark window gives you a glimpse of the internals and dampers the bright LED lighting to a more low-key level. To showcase the GPU, MSI uses a PCIe riser cable and vertically mounts the GPU, which gives you a good look at MSI's custom TWIN FROZR VI cooler.

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

We also like that MSI installs the GPU into its own chamber to prevent GPU heat from affecting other components. The Infinite A also features a separate chamber for the PSU and one for the CPU and primary system components, so there are three chambers in all. MSI has used this compartmentalized design in previous small form factor systems, and we also like it in this larger Infinite A rig.

Hardware-wise, the Infinite A is what you'd expect from a modern gaming rig. MSI aims to maximize frames without going overboard in a single area. As such, you won't find an Intel Skylake-X processor or AMD Ryzen Threadripper in this system. Instead, Intel's Core i7-7700 is a smart choice to power everyday productivity. This quad-core chip features Hyper-Threading, 8MB of Intel SmartCache, and a 3.6GHz base frequency (4.2GHz Turbo Boost). MSI also installs 16GB of DDR4-2400 memory, which should be enough for most gamers.





Sound is just as big a part of the gaming experience as your frame rate, so MSI includes its Audio Boost technology that features a hardware amplifier to deliver premium audio fidelity. To enhance multichannel audio, the Infinite A desktop also comes with Nahimic 2. This sound processing technology can expand the audio field to 7.1-channel surround sound over a regular stereo headset. Nahimic also provides VR audio algorithms to enhance the 3D sound field over HDMI and USB outputs.

a bit of an oddball among the Infinite





A series when it comes to storage. All models feature a PCIe SSD for the OS drive (our build comes with Samsung's 512GB SM961), but the VR7RE-007US lacks a secondary drive for mass file storage. On the other Infinite A models, MSI includes both a PCIe SSD and a 2TB HDD. On the plus side, there's plenty of room and available SATA connections to add SSDs or HDDs.

For \$1,699.99, the Infinite A proved to be a capable gaming system in our benchmark testing. In Metro: Last Light, we saw 101 frames per second at the highest settings and a resolution of 2,560 x 1,440, while DX12 testing with Sniper Elite 4 produced 136fps. Frames in the Witcher 3 were also respectable with 77fps. Intel's Core i7-7700 showed well with a score of 889 in Cinebench 15 and 1,864 pixels per second in POV-Ray 3.7.

The Infinite A is similarly priced to an off-the-shelf gaming desktop, yet it offers a level of polish that you won't see from the local big box store. And with Christmas on the way, we'd highly recommend the system as a gift for the gamer in your life who's not yet ready (or interested) in building their own rig.

BY NATHAN LAKE

The VR7RE-007US configuration is System Specs: Processor: Intel Core i7-7700; Motherboard: MSI B250M BAZ00KA; GPU: MSI GeForce GTX 1080 Gaming; Memory: 16GB Kingston DDR4-2400; Storage: 512GB Samsung SM961; PSU: 550W (80 PLUS Bronze); OS: Windows 10 Home (64-bit)

Benchmark Results	MSI Infinite A (VR7RE-007US)
3DMark Fire Strike Extreme	9531
Graphics Score	10442
Physics Score	12637
PCMark 10	5975
Essentials	8869
Productivity	8263
Digital Content Creation	8523
SiSoftware Sandra 2017 SP2	
Dhrystone AVX2 (GIPS)	192.55
Whetstone AVX (GFLOPS)	108.44
Multi-Media Integer AVX2 x32 (Mpixels/s)	518
Multi-Media Long-int AVX2 x16 (Mpixels/s)	187.2
Multi-Media Quad ALU x1 (Mpixels/s)	3.07
Floating B/F AVX/128 (GBps, mem bandwidth)	24.11
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	2980
Sequential Write (Q32T1)	1642
Random 4K Read (Q32T1)	685.2
Random 4K Write (Q32T1)	493.2
POV-Ray 3.7 (Pixels/s)	1,864
Cinebench 15 (Points)	889
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF; SSAA off)	101fps
Sniper Elite 4 (VSync off, Ultra, DX12)	136fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	77fps





SUPERO C7Z370-CG-IW \$199.99 Supermicro www.supero.com

SUPERO C7Z370-CG-IW

When it comes to small form factor mainboards, motherboard companies often make a few microATX options and only one or two Mini-ITX boards for a given chipset. With Intel's new Z370 chipset, there are currently only a few Mini-ITX models on the market. The SUPERO C7370-CG-IW is a welcome addition to the Mini-ITX fray, and it comes with many of the features we liked on the ATX-sized SUPERO C7Z370-CG-L.

Trimming the Z370 chipset down to the Mini-ITX form factor does mean that Supermicro has to make some layout changes—when compared to the C7Z370-CG-L. Like every other Mini-ITX Z370 motherboard available, the CZ370-CG-IW has only two DIMM slots and one PCIe 3.0 x16 slot. In the two DIMM slots, you'll be able to install up to 32GB of memory and Supermicro supports overclocked memory up to 3,733MHz and Intel XMP settings. The 3,733MHz OC speed is appreciably higher than the DDR4-2800MHz maximum speed on the SUPERO CZ370-CG-L.

We like that Supermicro is able provide two M.2 slots (M-Key) by locating one of the slots on the back of the PCB, while the other is just above the PCIe x16 slot. The two 32Gbps M.2 slots (type 2280) can be set up in RAID 0 or 1, so you can get the most out of two PCIe SSDs. For SATA SSDs and HDDs, there are four 6Gbps SATA ports that support RAID 0, 1, 5, and 10.

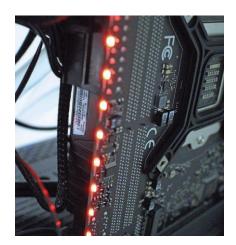
Connectivity is similar to what you'd find on a full-size ATX motherboard. The rear panel features four USB 3.0 ports, two USB 3.1 ports (1 Type-A, 1 Type-C), and a PS/2 port. Two additional USB 3.0 ports and two USB 2.0 ports are available via internal headers. If you plan to use an Intel processor's integrated graphics, Supermicro provides an HDMI port and a DisplayPort output.

One of the big benefits of a small form factor system is its portability, and most Mini-ITX motherboards feature onboard Wi-Fi to let your SFF rig connect to the Internet when you're away from a wired connection. The SUPERO C7370-CG-IW features two Wi-Fi antenna ports on the rear panel, as well as an Azurewave AW-CB295NF wireless module that supports 802.11ac and Bluetooth. For wired connectivity, the onboard Ethernet port is powered by Intel's i219V NIC.

Supermicro does a good job on the SUPERO C7370-CG-IW ensuring Intel's 8th Generation processors will function without limitations. The CPU socket features gold plating that's 15 microns thick, which should eliminate galvanic corrosion and provide a reliable connection with your Coffee Lake processor. The Mini-ITX form factor doesn't leave much space for heatsinks, but Supermicro manages to fit a tall, slim heatsink over the VRM, as well as a thicker, shorter heatsink on the PCH, to cool the board's power handling areas.

If your miniature system includes a chassis with a side-panel window, you'll like that the SUPERO C7Z370-CG-IW features RGB LEDs along the right edge of the PCB. In addition to the color, Supermicro allows you to customize the effects with preset Alarm, Breathing, Meteor, and Rainbow patterns, among others. Even considering the rise of RGB LEDs, many recent Mini-ITX

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



motherboards lack LEDs, as there's often not room on the PCB. Typically, motherboard makers face onboard LEDs forward, but on the SUPERO C7Z370-CG-IW, Supermicro points the LEDs to the back with illumination appearing to come from the side of the board. In our test system, the back-facing LEDs also reflected off the motherboard tray, creating a backlighting effect.

One of Supermicro's new additions to its SUPERO motherboards is the SUPERO Booster utility and a revamped BIOS. The new BIOS and software utility make it easy to overclock your 8th Generation Intel processor. Previous Supermicro motherboards, of course, allowed you to overclock the CPU and memory, but the interface was a bit clunky, in comparison to other modern BIOSes. SUPERO Booster-in particular—offers an intuitive interface that lets you fine-tune CPU and memory speeds and voltages. You can also switch between multiple overclocking profiles and control fan speeds.

We maxed out the SUPERO C7Z370-CG-IW by installing Intel's Core i7-8700K, 16GB of Corsair Vengeance





DDR4-3000, EVGA's GeForce GTX 1080 Ti FTW3 GAMING, and a 480GB Patriot Hellfire SSD—components we've used when reviewing full-size Z370 motherboards. And with the high-end hardware installed, the SUPERO C7Z370-CG-IW did excellent in our benchmark tests. A few of the highlights include 93fps in Witcher 3 (at Ultra settings and a resolution of 2,560 x 1,440), 1360 points in Cinebench 15, and 29.6GBps in SiSoftware Sandra's Memory Bandwidth test.

Supermicro touts the SUPERO C7Z370-CG-IW as "loaded with features that all gamers and enthusiasts would enjoy in a small, portable package," and we agree. Support for overclocked memory (up to DDR4-3733) and RAID PCIE SSD configuration are particularly notable additions for any Mini-ITX board. At \$199.99, the SUPERO C7Z370-CG-IW is one of the more costly Mini-ITX motherboards available, but it has the amenities to please power users.

BY NATHAN LAKE

Specs: Max memory: 32GB DDR4 (DDR4-2666; Max OC: DDR4-3733); Slots: 1 PCle 3.0 x16; Storage: 2 M.2 (type 2280), 4 6Gbps SATA; Rear I/O: 1 HDMI 2.0, 1 DisplayPort 1.2, 1 PS/2, 2 USB 3.1 (1 Type-A, 1 Type-C), 4 USB 3.0, 1 Ethernet, Wi-Fi antenna ports, 1 S/PDIF, audio I/O; Form factor: Mini-ITX; Warranty: 3 years

Test System Specs: Processor: Intel Core i7-8700K; GPU: EVGA GeForce GTX 1080 Ti FTW3 GAMING; Memory: 16GB Corsair Vengeance DDR4-3000; Storage: Patriot 480GB Hellfire; OS: Windows 10 Enterprise

TX 1080 Ti FTW3 BOGB Hellfire; OS: 5 = ABSOLUTELY PERFECT

Benchmark Results	Supermicro SUPERO C7Z370-CG-IW
3DMark Fire Strike Extreme	12901
Graphics Score	13937
Physics Score	16523
PCMark 10	6351
Essentials	9457
Productivity	8145
Digital Content Creation	8988
SiSoftware Sandra 2017 SP3	
Dhrystone AVX2 (GIPS)	229.4
Whetstone AVX (GFLOPS)	165.88
Multi-Media Integer AVX2 x32 (Mpixels/s)	805.26
Multi-Media Long-int AVX2 x16 (Mpixels/s)	285.7
Multi-Media Quad ALU x1 (Mpixels/s)	4.65
Floating B/F AVX/128 (GBps, mem bandwidth)	29.6
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	2458
Sequential Write (Q32T1)	1553
Random 4K Read (Q32T1)	622.7
Random 4K Write (Q32T1)	541.1
POV-Ray 3.7 (Pixels/s)	2840
Cinebench 15 (Points)	1360
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF; SSAA off)	120fps
Sniper Elite 4 (VSync off, Ultra, DX12)	145fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	93fps





MAGNUS EN1060K \$899.99 ZOTAC www.zotac.com

ZOTAC MAGNUS EN1060K

ig and bold is generally what comes D to mind when we talk about gaming PCs, especially with custom-built power user rigs. But a full or mid-tower chassis is by no means a requirement thanks to the power-efficient design of modern CPUs and GPUs. As an example, look no further than ZOTAC's MAGNUS lineup. These miniature PCs feature an NVIDIA GeForce GTX 1060, 1070, or 1080 graphics card and an Intel Kaby Lake desktop processor. ZOTAC sent us a barebones model of MAGNUS EN1060K preassembled with Intel's Core i5-7500T and NVIDIA's GeForce GTX 1060. The company also offers a complete MAGNUS EN1060K system (ZBOX-EN1060K-U-W2B) with memory, storage, and Windows 10 already installed.

The MAGNUS EN1060K is a little bigger than your average set-top box with dimensions of 2.45- x 7.99- x 8.27-inches

(HxWxL). The ultra-slim chassis features a basic black exterior and should blend nicely into most entertainment centers. Anyone considering this system for VR or gaming on the big screen will like that the onboard GeForce GTX 1060 is powerful enough to drive either experience and comes with the GTX 1060's full complement of 6GB GDDR5.

The integrated GeForce GTX 1060 can drive up to four display outputs, which includes two HDMI 2.0 ports and two DisplayPort 1.3 ports on the rear panel. All of the MAGNUS EN1060K video outputs support 4K at 60Hz. I/O connectivity is also respectable for a small form factor system. The front panel boasts two USB 3.1 ports (one Type-A and one Type-C), a 3-in-1 SD card reader, and analog audio I/O. On the rear panel, there are two USB 3.0 ports, two USB 2.0 ports, and two wired Gigabit LAN ports. ZOTAC also builds in wireless connectivity with support for 802.11ac/ b/g/n and Bluetooth 4.2.

Everyday productivity is covered by Intel's Core i7-7500T. This quadcore processor features a 2.7GHz base frequency and a 3.3GHz Turbo Boost speed. The MAGNUS EN1060K does a good job supporting modern memory and storage options. On this barebones model, we installed 32GB of HyperX Predator DDR4-2133, and the system supports up to 32GB of 2400MHz memory.

Storage-wise, ZOTAC makes room for both an M.2 SSD (we installed Patriot's 480GB Hellfire) and a 2.5-inch SATA SSD or HDD. We like that ZOTAC gives you the option of a 2.5-inch drive, as it gives budget builders an affordable option for an OS drive and enthusiasts can have a storage drive on top of a speedy PCIe SSD in the M.2 slot. For an OS, the MAGNUS EN1060K supports Windows 8.1 and 10.







One area where the MAGNUS EN1060K really stands out is the ease-of-access you have to components—all the more important if you opt for the barebones kit. Oftentimes, small form factor systems have a notebook-like design where there are lots of tiny screws to remove and reinstall when working on the system. On the MAGNUS EN1060K, all you'll need to do is unscrew two thumb screws (on the rear panel) and slide off the bottom cover. Once open, you'll have convenient access to the system memory and storage—both the M.2 slot and 2.5-inch bay.

The MAGNUS EN1060K was a capable performer at 2,560 x 1,440, and it's notable that the system delivered playable frame rates (37fps) in the GPU-demanding Witcher 3. We saw near 60fps in the less intensive Metro: Last Light (51fps) and Sniper Elite 4 (56fps). Bumping resolution down to 1080p brings frame rates up above 60 in all our gaming tests. The remaining benchmark numbers won't necessarily "wow" you,

especially if you compare them to topof-the-line Kaby Lake processors. But considering the barebones system's \$899.99 MSRP, we expect you shouldn't have any problems with multimedia and productivity applications. Anyone considering the MAGNUS EN1060K for a home theater environment should like that, even under full load, the active cooling system was barely audible.

ZOTAC's MAGNUS EN1060K is ideal for people who want to move the gaming experience to the big screen or need a VR system that won't look out of place in the home theater. Power users who want some flexibility with component choice can opt for the barebones design, while others who need something functional right out of the box can pick the model with memory, storage, and OS installed. The exceptionally quiet design also might make it appealing for a home office PC that secretly packs some gaming punch.

BY NATHAN LAKE

Barebone Specs: Processor: Intel Core i5-7500T: Chipset: Intel B150; GPU: NVIDIA GeForce GTX 1060 (6GB GDDR5); Memory: Supports up to 32GB DDR4-2400/2133, 2 SO-DIMM slots; Storage: Supports 1 2.5-inch SSD/HDD and 1 M.2 PCle/SATA SSD; PSU: AC Adapter; Front panel: 2 USB 3.1 (1 Type-A, 1 Type-C), audio I/O, 3-in-1 SD card reader; Rear panel: 2 USB 3.0, 2 USB 2.0, 2 HDMI, 2 DisplayPort, 2 Ethernet, 1 Wi-Fi SMA connector

Test System Specs: Processor: Intel Core i5-7500T; GPU: NVIDIA GeForce GTX 1060 (6GB GDDR5); Memory: 32GB HyperX Predator DDR4-2133; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

Benchmark Results	ZOTAC MAGNUS EN1060K
3DMark Fire Strike Extreme	4799
Graphics Score	5221
Physics Score	6814
PCMark 10	3972
Essentials	7791
Productivity	7025
Digital Content Creation	3109
SiSoftware Sandra 2017 SP2	
Dhrystone AVX2 (GIPS)	96.42
Whetstone AVX (GFLOPS)	57.09
Multi-Media Integer AVX2 x32 (Mpixels/s)	293.4
Multi-Media Long-int AVX2 x16 (Mpixels/s)	118.77
Multi-Media Quad ALU x1 (Mpixels/s)	1.4
Floating B/F AVX/128 (GBps, mem bandwidth)	26.1
CrystalDiskMark 5.2.2 (MBps)	
Sequential Read (Q32T1)	2297
Sequential Write (Q32T1)	1566
Random 4K Read (Q32T1)	505.9
Random 4K Write (Q32T1)	391.9
POV-Ray 3.7 (Pixels/s)	1244
Cinebench 15 (Points)	510
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF; SSAA off)	51fps
Sniper Elite 4 (VSync off, Ultra, DX12)	56fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	37fps

























Freezer 33 TR \$47.99 ARCTIC www.arctic.ac

ARCTIC Freezer 33 TR

MD's Threadripper has changed Athe game for CPU cooler makers. The giant chip (72mm by 55mm) isn't compatible with many existing CPU coolers—often due to the CPU's length and even if the cooler's cold plate is big enough, power users might not be able to purchase a compatible mounting bracket. ARCTIC Freezer 33 TR is engineered to work with Threadripper and AMD has tested and approved the CPU cooler for the 1900X, 1920X, and 1950X processors. ARCTIC also designs the Freezer 33 TR to support processors that fit into AMD's AM4 socket and Intel's 2066 and 2011-3 sockets.

The Freezer 33 TR builds upon ARCTIC's Freezer 33 series cooler. It's basically the same heatsink with a longer base that accommodates Threadripper's rectangular chip, as well as Intel's big, high-power processors, such as the Skylake-X line. The heatsink itself consists of four 6mm heatpipes that

make direct contact with the CPU's heat spreader, plus a stack of 49 0.5mm-thick aluminum fins. ARCTIC also improves Freezer 33 TR's fan by including its new BioniX F120 fan that boasts a wide PWM range of 200rpm to 1,800rpm.

At the fans' full 1,800rpm, the BioniX F120 fan delivers 69cfm to quickly move hot air away from the air cooler's heatpipe and fin structure. ARCTIC rates the BioniX F120 with a maximum noise level of 0.5 Sone, and in our experience, fan noise at full throttle was just a bit quieter than air coolers with high-speed 2,000rpm fans. The BioniX F120's 200rpm minimum PWM speed allows the Freezer 33 TR to operate quietly during idle or basic duties.

The design changes to the Freezer 33 TR allow ARCTIC to bump the cooler's recommended TDP to 200 watts (up from 150 watts on the Freezer 33) with a maximum cooling capacity of 320 watts. If you need additional cooling capacity

for your processor, ARCTIC includes a second set of fan brackets to create a push-pull configuration with the included BioniX F120.

The Freezer 33 TR proved itself worthy in our testing with AMD's Ryzen Threadripper 1950X. The processor idled at an average temperature of 31.7 degrees Celsius. When we fired up POV-Ray 3.7 for 10 minutes, temps were still chill with an average temp of 58.5 C and maximum of 69 C. It was similarly good in Prime95, where we recorded an average of temp of 66.2 C and a max of 71 C.

An MSRP of \$47.99 puts the Freezer TR 33 in extremely affordable territory for a TR4-ready CPU cooler. And there's enough cooling performance to keep the 1950X, AMD's most powerful Ryzen Threadripper, from throttling under extreme loads. It's a good value.

BY NATHAN LAKE

Specs: Materials: Copper (base, four 6mm heatpipes), aluminum (fins); Fan: BioniX F120 (200 - 1,800rpm); Cooler dimensions: 6.1 x 3.5 x 4.8 inches (HxWxL); Socket compatibility: Intel LGA 2066/2011(3), AMD TR4/AM4; Warranty: 10 years

Test System Specs: Processor: AMD Ryzen Threadripper 1950X; Motherboard: GIGABYTE AORUS X399 Gaming 7; GPU: GIGABYTE AORUS GeForce GTX 1080 Ti 11G; Memory: 32GB HyperX Predator DDR4-3000; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise



HP SSD M700 240GB

This time of year, we hope that our loved ones are wise enough to give us the gift of PC hardware. Naturally, we can't always rely on friends and family to have impeccable component clairvoyance, so it never hurts to offer them a little helpful "guidance." As you assemble your own wish list (hint: don't forget to check out our annual "Holiday Gift Guide" in this issue), be sure to include a decent number of stocking stuffers. As it happens, HP's SSD M700 6Gbps SATA drives are a nice candidate.

While you've busied yourself obsessively following any and all developments related to PCIe SSDs, their 6Gbps SATA kin keep getting cheaper and cheaper and cheaper. The 240GB SSD M700 we're reviewing only costs \$99.99, and we were able to find it for sale online a little cheaper than that—just under 80 bucks. Hunt for the 120GB SSD M700 and you'll likely scare up a similar deal. In fact, we had the opportunity to buy the smaller of HP's SSD M700s for \$45.99. Whether you need to upgrade a sluggish old laptop, have a tiny mountain of files that you regularly access, or simply want a crazy-affordable boot drive for a budget build, these two solid-state drives will give you some punch without putting much of a dent in your pocketbook.

Pop the top of the SSD M700 and you'll find a dual-core storage controller and a batch of planar MLC NAND. There are four memory channels, and they support NANDXtend technology, which, as you might guess, helps get more mileage out of the SSD M700's NAND. For example, the drive's higher order LDPC error correction allows for high-speed parallel decoding and real-time error correction. Write acceleration and an SLC cache algorithm help bolster the SSD M700's performance. HP says the 240GB SSD M700 should be good for sequential reads and writes of 560MBps and 520MBps, respectively; likewise, the drive's random performance

SSD M700 240GB

\$99.99

HP I www.hp.com

Benchmark Results	HP SSD M700 240GB	
CrystalDiskMark 5.2.2*		
Sequential read	545.5	
Sequential write	485.8	
4K read	53.15	
4K write	129.5	
Sequential read (QD32)	555	
Sequential write (QD32)	502.1	
4K read (QD32)	337.6	
4K write (QD32)	307.3	
AS-SSD 2.0*		
Sequential read	525.58	
Sequential write	398.12	
4K read	33.09	
4K write	107.9	
4K read (64Thrd)	213.94	
4K write (64Thrd)	294.54	
*all results in MBps		

peaks at 75,000 IOPS (reads) and 80,000 IOPS (writes). In our testing, the SSD M700 largely lived up to expectations.

Despite the SSD M700's performance, HP's new drives face an extremely crowded field. The SSD M700 is compatible with HPdst.exe (HP Software Pre-installation Environment), which may give it an edge for anyone upgrading an existing HP PC, but other buyers face tough choices. Regardless, we're glad that HP is in this game and hope the company keeps playing.

BY VINCE COGLEY

Specs: Interface: 6Gbps SATA; Dual-core storage controller; Maximum sequential read/write: 560MBps/520MBps; Random 4KB read/write: 75,000 IOPS/80,000 IOPS; Form factor: 2.5-inch; Warranty: 5 years

Test system specs: Processor: Intel Core i7-7700; Motherboard: MSI B250 Gaming Infinite; GPU: NVIDIA GeForce GTX 1080; Memory: 16GB DDR4-2400; OS Drive: Samsung SM961 512GB: OS: Windows 10

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT





Dark Base 700 \$179.90 be quiet! www.beguiet.com

be quiet! Dark Base 700

Base 900 from the German component maker be quiet! and liked it so much that we awarded the case our seldom-used CPU Cutting Edge Award for innovative design. Our review, which appeared on the website and in the July 2016 issue, had this to say: "There are a lot of cases on the market today that provide some degree of modularity, but the be quiet! Dark Base Pro 900 takes the concept of modular design to a whole new level, and that's why we've awarded it the CPU Cutting Edge Award."

Now be quiet! has sent us a case that we like even more: the Dark Base 700, a mid-tower that is every bit as flexible in accommodating all kinds of builds as the 900, but adds a few features that sweeten the deal.

Like the DB900, the 700 gives builders complete freedom to build either a traditional, left-facing build or to invert everything and build facing right. In order to accomplish this, you can remove the motherboard tray, a sizable portion

of the rear panel, the dual-bay drive cage, and the panels that make up the power supply shroud. (The power supply shroud is new; more on that in a moment.) All of those things can be reoriented to facilitate an inverted build, and to top it all off, you can remove the mounting hardware that supports the Dark Base 700's tempered-glass side panel and move it around to the right side, as well, and then fasten the steel panel on the left.

The power supply shroud runs the full length of the interior out of the box, but like the rest of the interior is highly modular. You can pop any or all of the four plastic panels on its top out quickly and easily if, for example, you want to install a radiator behind the front panel (it supports rads up to 360mm long), or if you want to remove the drive cage below and mount a reservoir/pump unit there. The side panel (the one that faces toward the glass side panel) of course comes off, as well, and you can flip it around and mount it on the right side.

Speaking of new additions, be quiet! also gives the Dark Base 700 some cool LED accent lighting in the form of a pair of strips that run along the sides of the front panel, from top to bottom. Using a button at the front of the top panel, you can set the strips to white, red, green, blue, orange, or purple, and you can make them continuous or set them to "breath" mode so that they fade in and out. There's also an internal lead that you can attach to a header on your motherboard if available and let your board control the lights, giving you access to their full RGB color range.

The LEDs are a nice addition to what we think is be quiet!'s best-looking case yet; the smooth, brushed-aluminum front and top panels are gorgeous, and combined with the tempered-glass side panel give the Dark Base 700 a look that's both luxurious and high-tech. If this case were a car, it would be a BMW M5 or a Mercedes AMG E Class sedan. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 20.43 x 9.5 x 21.42 inches (HxWxD); Materials: steel, tempered glass, aluminum, plastic; Motherboard support: Mini-ITX, mATX, ATX, EATX; Drive bays: 3 x 3.5-inch internal, 9 x 2.5-inch internal; Fans (included): 1 x 140mm front, 1 x 140mm rear; Fans (optional): 2 x 140mm or 3 x 120mm front, 3 x 120mm/140mm top, 1 x 120mm/140mm PSU shroud, 1 x 120mm/140mm bottom; Ports: 1 x USB 3.1, 2 x USB 3.0, audio I/O





Z-Machine X7 \$299 Zalman www.zalman.com

Zalman Z-Machine X7

alman's Z-Machine sub-brand of high-end PC gaming products has been around for quite a while, but the brand's newest offering, the Z-Machine X7, is the first one we've been hands-on with in some time. The X7 is a full-tower enclosure that is packed to the gills with modern case features designed to keep builders happy and make builds look great. Everything starts up front with the X7's brushed-aluminum front and top panels; the case has a few plastic bits here and there, but by and large it's a steel frame, a steel motherboard tray and power supply shroud, aluminum panels, and a pair of tempered-glass side panels.

As you can imagine, a full tower with this much hefty aluminum and glass is fairly heavy, but not prohibitively so. Zalman went with the smooth, uninterrupted panels that are all the rage these days, but used some nice design elements to still allow plentiful airflow opportunities; sort of a cake-and-eatit-too scenario. For instance, there are baffled intakes that run all along the front of the left and right sides of the case that ensure all

the X7's three, pre-installed 120mm RGB LED fans can pull in as much air as needed, with or without an attendant radiator (up to 360mm in length). Up top, the brushed aluminum runs about three-quarters of an inch above a lower, well-ventilated steel panel that also accommodates a triple rad.

The motherboard tray has many of the modern design notes you'd expect, including plenty of rubber-grommeted cablemanagement holes, a generous cutout for cooler installation, and some very handy plastic graphics card supports that you can set to any height along the range of PCI expansion slots that you need. While we're on the subject of VGA supports, we should point out one of the X7's coolest features; Zalman includes a steel bracket mounted on the power supply shroud that lines up with one of the case's two vertical expansion slots. If you add a vertical GPU mounting kit with ribbon cable, you can easily mount your graphics card so that it's the focal point of your build when folks gaze through the tinted glass side panel on the X7's left side.

It's not the first vertical GPU-mounting setup we've seen in a case, but they are still rare enough these days in a stock chassis that we take special notice of them.

The PSU shroud also has a really cool "Z-Machine X7" cutout on its outward (left) side, and the white plexi behind the cutout is LED backlit. Combine this with the LED fans and the Zalman ZM-MFC5 fan and lighting controller pre-installed at the front and top of the left side just behind the power and reset buttons (and just above the case's USB and audio ports), and you have a very cool lighting system that's ready to plug in and go right out of the box.

Zalman's Z-Machine X7 is big, bold, and beautiful. Its six 3.5-inch drive bays and five 2.5-inch drive mounting brackets hold a lot of storage, and the case supports motherboards up to EATX, as big a graphics card as you can find, and all the custom cooling gear you'll ever need. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 23.1 x 9.1 x 24.3 inches (HxWxD); Materials: steel, tempered glass, aluminum, plastic; Motherboard support: Mini-ITX, mATX, ATX, EATX; Drive bays: 6 x 3.5-inch internal, 5 x 2.5-inch internal; Fans (included): 3 x 120mm LED front, 1 x 120mm LED rear; Fans (optional): 3 x 140mm front, 3 x 140mm top, 2 x 120mm PSU shroud, 1 x 140mm rear; Ports: 4 x USB 3.0, audio I/O

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT





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PrimoChill Vue Coolant

Not all liquid coolants are created equally, and PrimoChill knows this; that's why they have a variety on offer. One of the company's newest varieties is Vue, a liquid that puts the "cool" in coolant. We got a 32ounce bottle of the coolant in Candy Purple SX. As we went to press, there were 19 colors to choose from, though not all were in stock. This is a pre-mix fluid, which means it's ready to add to your loop straight from the bottle. When your liquid cooling system is off, the fluid appears opaque and a uniform color, but once you fire the system up, the fluid's unique dye swirls with a pearlescent luster.

It not only looks fantastic, but it also lets you follow the flow of the fluid through your components.

Like any decent pre-mix coolant, Vue

Like any decent pre-mix coolant, Vue is a water-based fluid, non-toxic, and environmentally-friendly. PrimoChill mixes Vue in small batches to ensure consistent color and the highest quality. The coolant also naturally acts as an antimicrobial, to help keep your system free from efficiency-reducing buildup. We've had a bottle of opaque coolant from

another brand sitting on a drawer for a year or so, and there's a significant amount of sediment that separates out and clumps up. Although we haven't had the Vue for

The coolant naturally acts as an antimicrobial to reduce buildup.

long, there's no signs of particulates or settling at the bottom of the bottle even after a couple days remaining motionless.

PrimoChill recommends its Vue coolant to experienced users, largely because–like with any opaque coolant–you should flush and refill the coolant at least every six months. For those looking for fluids that'll last longer between maintenance, PrimoChill recommends something like its True Transparent or PC Ice coolants in a clear blue or green color. Opaque coolants

like Vue may stain your PETG, acrylic, or rubber tubing, so when you perform your flush and refill, make sure you cut, bend, and run new tubing as well.

When it comes to gunk buildup, however, we didn't have the opportunity to determine how Vue holds up after a six-month run. But there are a handful of videos on YouTube showing component teardowns, and Vue tends to perform very well. According to a JayzTwoCents video (http://bit.ly/2BnBsYL), not only was there little to no buildup, but Vue actually managed to scour the copper and nickel-plated fins of a CPU and GPU block, to the point that very

little extra effort was necessary to get the components ready for reinstallation. This is no small feat for an opaque coolant.

Although not everyone can perform a full system teardown as often as Vue demands, for those who can, it performs well and adds a completely unique and eye-catching aesthetic to any hardline or soft-tubing liquid cooling system.

BY ANDREW LEIBMAN

State-Of-The-Art Standards AMD Enhanced Sync

uried among Dthe handful of game-specific performance improvements, bug fixes, and feature tweaks included in Radeon Software Crimson ReLive Edition 17.7.2, AMD's graphics driver software package released on July 26th, is a new feature called Enhanced Sync. According to AMD, this display technology sits somewhere between VSync (vertical synchronization, or "wait for vertical



Enhanced Sync works like VSync, only without hammering your frame rates and killing your response time.

refresh") and FreeSync and works similarly to improve the look and feel of your games as the frame rate fluctuates. To dig a little deeper into why Enhanced Sync is such a game changer, we'll explore the benefits and drawbacks of VSync and touch on the dynamic frame pacing technologies offered by both AMD and NVIDIA.

The Gamer's Bane

Screen tearing is the visual artifact in which the top portion of the on-screen image becomes misaligned with the bottom portion of the image, making any vertical lines in a game appear broken and shifted. It is most often visible when the player is relatively quickly swiping his or

her viewpoint to the right or left across the scenery. Tearing is most apparent in certain game types, such as first-person shooters, racing games, and third-person action games. Quickly scrolling across a map in an RTS game can also induce the artifact. The primary objective of the various frame syncing technologies we'll talk about in this article is to eliminate screen tearing, and some are more effective than others without introducing further unwanted artifacts, such as stuttering and input delay.

Benchmarks vs. VSync

You may know of VSync as the original method of eliminating screen tearing. But as you've probably noticed in pretty much every graphics card review you read, including the ones we do, VSync is one of a handful of settings that is routinely turned off to get the in-game frame rate scores. This is because under VSync, the display only draws unique frames at set intervals, depending on your monitor's refresh rate. In short, when VSync is enabled, the frame rate is artificially capped to match the monitor's refresh rate, and you're not getting an accurate picture of the hardware's peak performance.

To give you an example, we recently wrapped up our review of the BenQ



VSync reduced the power our Radeon RX Vega 64 was consuming by preventing it from rendering frames we'd never see.

PD2710OC, a 60Hz monitor with a 2,560 x 1,440 native resolution. When we run The Witcher 3: Wild Hunt in Borderless Window mode (this mode ensures frame buffering is working properly) on a system equipped with a Radeon RX Vega 64 Liquid Cooled Edition graphics card, the frame rate hovers between 88 and 95 frames per second, but every frame above the monitor's refresh rate cap is effectively being rendered and discarded without ever being drawn on screen. As a result, between 31% and 37% of the graphics card's output is completely wasted on this game, and this is the best-case scenario with such a monitor. It's for this reason that we recommend getting a high-refresh-rate monitor to anyone running a high-performance graphics card.

The Frame Time Rollercoaster

It's true, some games tend to suffer from more screen tearing than others. Overall, frame rates have less impact on the smoothness of gameplay than do frame times, which refer to the amount of time it takes a particular piece of graphics hardware to render a given frame. Robert Hallock, head of global technical marketing at AMD, points out that in an ideal 60fps gaming scenario, there are 60 frames fully rendered from start to finish and shown on the screen every second. "That's a new picture every 16.66 milliseconds . . . or it would be, in a perfect world. In reality, the time to render a frame depends on how much detail is currently on-screen, and some frames can be a little slower or faster to complete as you look around."

Hallock describes a scenario where 60fps can still feel choppy. For instance, two adjacent frames rendered in 33 milliseconds could consist of frames taking 16.6ms each, or consist of an 8ms frame followed by a 24ms frame. "The FPS meter would still read 60fps in both cases, but the latter scenario might feel quite choppy as the fast-slow-fast-slow pattern creates a subtle jerkiness in motion." Incidentally, you may be curious to know how frame-counting applications handle tearing,

where portions of frames are overwriting previous frames. FRAPS, and similar tools, only count the number of times the front buffer is swapped out.

The Puh-Puh-Problem With VSync

The good thing about VSync is that it's effectively free. Practically all games support it and you don't need any specialized hardware to make it work. According to Hallock, VSync can eliminate screen tearing by ensuring that there's only ever one frame onscreen at a time. "There is a downside, the GPU may have to hold onto a rendered frame for prolonged and random intervals, which can cause the appearance of 'VSync stutter,' or choppy motion." This stutter occurs because the screen is refreshing faster than the graphics card can

render frames, which forces it to reuse already-buffered frames.

We haven't mentioned buffers yet, but understanding them is an important facet of understanding how these technologies work. When the screen needs to post a fresh image, pulling it from the graphics memory immediately as it finishes rendering causes the screen to flicker. For this reason, double-buffering was introduced. This lets the graphics hardware render a frame in a back buffer, and send it to a front buffer when called for. The front buffer is what's sent to the display for the user to see, which reduces the flickering effect. In the absence of frame syncing, tearing is what you see as the back buffer pushes an unfinished frame to the front buffer because the screen is calling for a new frame (refreshing) before it is fully rendered.

Double-buffering adequately solves flickering and can even deliver a smoother gaming experience when there are mild fluctuations in frame rendering times. However, gaps still occur, leading

to stuttering with VSync on and tearing with VSync off. The addition of a second back buffer, in a triplebuffering scheme, significantly improves smoothness and reduces the likelihood of tearing occurring. Some PC games let you manually enable or disable frame buffering, as triple-buffering can be slightly more taxing of your system's resources than double-buffering. Graphics drivers from both AMD and NVIDIA have triple-buffering settings, which you can enable or disable globally or on a per-application basis.

How Power Plays A Role

Running The Witcher 3: Wild Hunt on a 1440p screen with a fixed 60Hz refresh rate and a powerful graphics card like the Radeon RX Vega 64 is essentially a best-case scenario for VSync. When this tech is turned on, the graphics card doesn't have to work as hard, as it's not generating a ton of frames that never get drawn to the screen. With VSync off in the example described above, our graphics card was drawing roughly 265 watts consistently. When we turned VSync on, the power draw dropped to between 230 and

255 watts, depending on the demands of the scene. When you look at the times when the power draw drops off abruptly, this is indicative of a series of relatively fast frame times, but spikes in power draw indicate more demanding frame rendering is happening. These gaps in frame rendering times still resulted in stutter being apparent.

If you want to leave VSync off, but want to reclaim some of the wasted power that is being used to render unused frames, you can turn on AMD's FRTC (Frame Rate Target Control) setting, and set the maximum frame rate to your monitor's maximum refresh rate.

Hallock provides us with an ideal scenario for FRTC, saying "There are plenty of extremely fun games out there with modest hardware requirements, and they run at hundreds of frames per second. Two I'm playing right now are Space Engineers and 7 Days to Die. These two games run well over 100fps on my Acer XR341CK. Since that monitor is 75Hz, any frame rate that's higher than 75 is basically wasted my monitor will never show it! So I turn on Frame Rate Target Control in

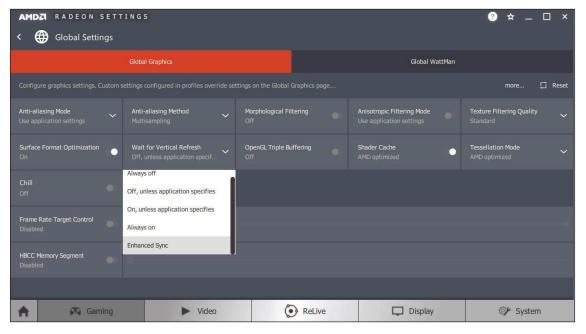
AMD's graphics driver to ensure that my GPU is only rendering up to the exact number of frames my monitor can show: 75. Now my GPU isn't using additional power, generating additional heat, or running the fan faster to render the 76-100+ frames I can't see. Some games feel perfectly smooth at even lower framerates, so I could turn the FRTC slider lower to gain even greater thermal/acoustic/power savings."

Although FRTC can impact power draw, depending on the title, it may have little effect on stuttering and the other major artifact introduced by these "cheap" frame-syncing technologies.

The Latency Liability

Hallock describes the other big problem with VSync, one that rears its ugly head even when the frame buffers are being swapped out and filled with fairly uniform frame times. "Having buffered frames is what allows the GPU to be ready the moment the monitor calls for a new image, but those buffered frames also mean that your mouse/keyboard movement could be two or three frames delayed as the

> GPU sits around waiting on the monitor to show that movement on-screen." Not all games require low latency input, but for those that do, such as twitch shooters like CS:GO, Overwatch, and Quake Champions, such delays can cost you critical milliseconds in your reaction time and lead to a frustrating gaming experience.



Enabling Enhanced Sync is easy for any AMD GPU user with a compatible Polaris or Vega graphics card.

The Expensive Solution

AMD and NVIDIA both have their own take on what's generically referred to as dynamic refresh rates. Effectively what this technology does is rescind the monitor's authority over how often the screen refreshes and gives it to the graphics card, the actual component that knows when frames are ready to be drawn to the screen.

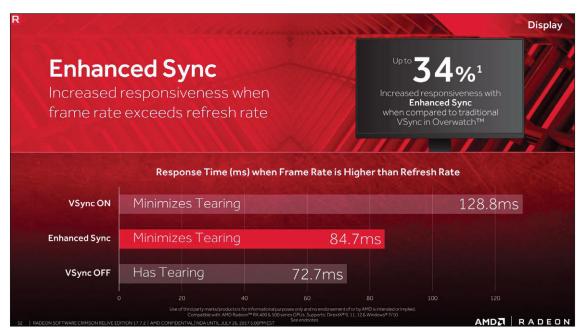
"I think a lot of gamers know how smooth PC gaming can be when We've talked about AMD's FreeSync and NVIDIA's G-SYNC before, and they both work relatively similarly. The primary difference between the two is that NVIDIA's option relies on a hardware scaler built into the monitor itself, whereas AMD's relies on the DisplayPort 1.2a standard extension (all monitors come with a built-in hardware scaler). In both instances, you'll need to purchase a monitor that supports either FreeSync or G-SYNC, and then

for free to anyone running a Radeon RX 400 series, RX 500 series, or RX Vega series GPU and the Radeon Software Crimson ReLive Edition, version 17.7.2 or newer. It works with most common game APIs, including DirectX 9, DirectX 10, DirectX 11, DirectX 12, and Vulkan. As we went to press, the new feature was not designed with multimedia applications in mind, and flickering and other issues may occur if you enable the feature for

all applications.

То turn on Enhanced Sync, make sure your hardware a n d driver version meet the required minimums, then right-click anywhere on the Desktop and click AMD Radeon Settings. Next, click the Gaming tab at the top of the UI, click the game you want to enable the feature on, or click Global Settings to enable it on all games, click the

Wait For Vertical Refresh drop-down menu, and then select Enhanced Sync.



Input latency is an important metric for competitive games and highly skilled gamers.

they hit that magical 60fps or 120fps threshold, and it's like everything gets amazingly buttery smooth," says Hallock. "Now imagine that amazing, buttery smoothness at virtually any frame rate, with no tearing, no VSync stutter, or no VSync input lag ever again. That's what AMD FreeSync is like. It's impossible to convey oncamera, but it's really life-changing for someone like me who plays games a ton. There's no chance I would ever go back to an ordinary monitor. Getting pristinely smooth and lowlatency gameplay, even at 33fps, is not something I'd trade for anything."

you'll need the corresponding vendor's graphics card to enable the technology. If you can stomach the startup cost, then the end result is eye-popping. It's truly the best experience for those who're serious about improving the look and feel of their everyday gaming.

AMD's Affordable Alternative

Enhanced Sync is a little different. Enhanced Sync is designed to minimize screen tearing while decreasing latency and stuttering at an unlocked frame rate. Perhaps the best part about Enhanced Sync is that it's a driver-based feature available

A Smarter Way To Sync

Enhanced Sync delivers an unlocked frame rate and reduces the input latency that occurs when the frame rate exceeds the monitor's refresh rate. When the frame rate dips below the monitor's refresh rate, Enhanced Sync automatically —and transparently to the end user— disables VSync, effectively preventing stutter from cratering your experience.

When ranking the technologies, AMD gives VSync credit for eliminating

tearing but introducing stuttering at refresh rates of 144Hz and lower. Above that, VSync minimizes tearing, but introduces input latency. Those twitch shooters we mentioned above? They often run at high refresh rates, so this latency can be a real deal-breaker.

Enhanced Sync is another step in the right direction, providing a better experience at low refresh rates where it allows some tearing but significantly less stutter. Above 144Hz, Enhanced Sync delivers lower latency, but functions similar to VSync in terms of eliminating same screen tearing.

FreeSync is still the pinnacle of syncing technologies for AMD GPU users, offering low latency, minimal tearing, and decreased stutter between the monitor's stated FreeSync range, up to 30Hz and 240Hz. But Enhanced Sync is designed to work in concert with FreeSync, by eliminating tearing when the refresh rate exceeds the FreeSync monitor's upper refresh rate limit.

Our Experience

We ran the Assassin's Creed Origins

built-in benchmark, with game settings at Very High, FPS Limit turned off, resolution at $2,560 \times 1,440$ and Adaptive Quality off. Our test system consists of an ASRock X299 Taichi, Intel Core i9-7980XE, AMD Radeon RX Vega 64 Liquid Cooled Edition, 32GB of Corsair Vengeance LED DDR4-3200 DRAM, a 480GB Patriot Hellfire M.2 NVMe SSD, and

Windows 10 Enterprise. The monitor we used was the 60Hz Samsung U28E590D.

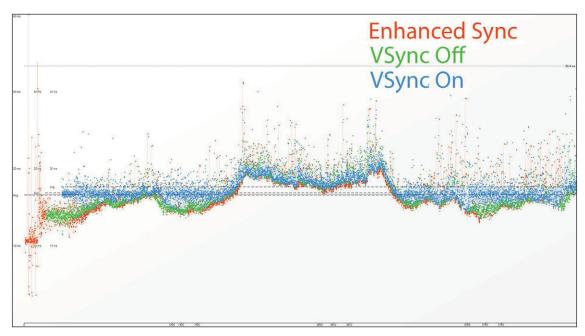
Our first test was to run the game with VSync turned off. While the test was running, frame rates hovered between 40fps and 65fps. We noticed some occasional tearing in the trees and buildings, both at the higher and lower frame rates. At the end of the run, we achieved a score of 7,215, with an average of 60fps. The second test we ran with VSync turned on, and as you'd expect, tearing was gone, but we did witness some mild stutter throughout the run. For this one, we achieved a 6,906 score, with an average of 57fps. Finally, we turned on Enhanced Sync from the AMD Radeon Software utility. We didn't notice any tearing and there seemed to be less stuttering overall. The test resulted in a 7,245 score, with an average framerate of 60fps.

If our impressions sound vague and even a little subjective, that's because trying to describe smoothness with the help of benchmarks numbers is difficult at best. We did use a frame time-capturing utility to do a more in-depth analysis of how that metric

impacted the smoothness of the game under each setting, but without looking at a plot, we're only able to give you averages. After comparing the plots, it appears as though Enhanced Sync had the lowest average frame time, right at 16.2ms. With VSync turned off, the average crept upward to 17ms. With VSync on, frame times took a hard hit, to the tune of 17.7ms.

Tear-Free

At the end of the day, the difference we experienced with Enhanced Sync is not jaw-dropping, but it did significantly reduce stutter, which is just as jarring as the tearing that VSync sets out to eliminate in the first place, if not more so. What's even more difficult to track is input latency. We all know that VSync is terrible for input latency when the frame rate exceeds the monitor's refresh rate, but Overwatch players will see up to 34% faster response time and significantly less tearing. Other competitive games offer similar results, making Enhanced Sync a no-brainer for those who loathe tearing as much as we do. ■



Enhanced Sync offers similar to slightly better frame times compared to the benchmark running with VSync Off.











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H.R. Giger Necronomicon

xactly one year ago, Ron Lee Christianson garnered his fourth "Mad Reader Mod" win with his amazing Aliens mod, and most fans of the Alien movie franchise are aware that the design of the titular xenomorph came from the mind of one Hans Ruedi "H.R." Giger.

"The Zurich-based artist was best known for airbrush images of humans and machines linked together in a cold "biomechanical" relationship," Christianson says. "Later he abandoned airbrush work for pastels, markers, and ink. He was part of the special-effects team that won an Academy Award for design work on the film 'Alien.'

Now Christianson is back in the pages of CPU with another Giger-inspired mod, the H.R. Giger Necronomicon. "I took a lot of inspiration from Giger's work to build this PC," Christianson says. "I watched his documentary 'Dark Star' several times, researched his sketches, paintings, and sculptures, and tried my best to emulate his style in this mod. Inspiration comes from everywhere for me, especially from other creative people."

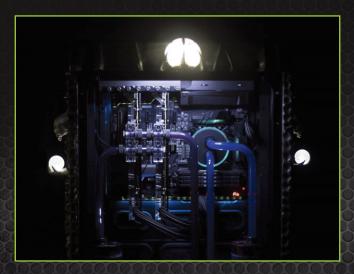
The real-life "H.R. Giger's Necronomicon" was a bound collection of Giger's art, published in 1977, whose title was undoubtedly an homage to the mysterious book mentioned several times in H.P. Lovecraft's various works. "Alien" director Ridley Scott apparently saw the book before hiring the Swiss artist to design the monster that launched six (and counting) movies.

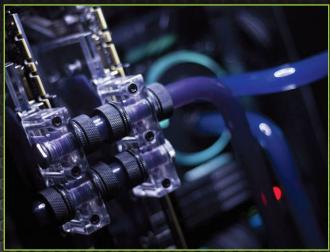
Christianson says he originally built the rig for Thermaltake to use in its booth at Computex 2017, but now uses it as his personal gaming rig. Incidentally, this is Christianson's fifth appearance in MRM, tied only by Brian "Boddaker" Carter and surpassed only by Bill "Mnpctech" Owen's nine appearances.

That Is Not Dead Which Can Eternal Lie

Located in Vancouver, Washington, Christianson's Blue Horse Studios (www.bluehorse-studios.com) creates clay forms and molds, airbrushed art and vinyl graphics, and of course modded PCs. Christianson says he spent a couple months just doing research on Giger's work in preparing for this mod, and then another three months of work to build it. "I made several design changes along the way and painted the entire piece two to three times to find the best color scheme," he says.

The Necronomicon began life as a Thermaltake Tower 900 case, but it was in for some dramatic . . . updates. "I gutted the interior and removed all the drive cages that I wouldn't need," says Christianson. "Next, I sanded the case completely down so the clay would bond well to the body of the chassis. I started sculpting all my detail pieces into foam, then covered them in Magic-Sculpt and added finer details. I





HARD HAT AREA PC MODDER MAD READER MOD

wired in all my accent lights, applied vinyl to the glass, and finished it all off with a custom paint job."

The other parts beneath the Necronomicon's grim, otherworldly exterior include an Intel Core i7-6700K, a GIGABYTE Z270X Designare motherboard, 32GB of HyperX DDR4 memory, a pair of NVIDIA GeForce GTX 1080 Founders Edition graphics cards, a Thermaltake 1200-watt power supply, a 240GB HyperX solid-state drive, and a 6TB WD hard drive for storage. The cooling subsystem consists of Thermaltake radiators, fittings, and fans, plus a Thermaltake pump, a Thermaltake reservoir, and Thermaltake PETG hard tubing.

Not To Beat A Blue Horse

As we are wont to do, we asked Christianson about his upcoming project (or projects in this case); "I have several on the bench that are in various stages of the build process. One of them is for the new Destiny 2 game and another based on the Netflix series 'Stranger Things.' I'm under NDA on the others and can't share at this time."

Christianson also tells us that he's working on getting regular content up on his YouTube channel again (www.youtube.com/user/RONLEEC1; there are already more than 30 excellent modding-related videos on the channel, including several that chronicle work on his Overwatch, Alien, and Biohazard mods). "My idea is to create a vlog-style video series. Life as an artist, sculptor, and PC modder. I'm shooting video now on all the projects I currently have going."





HARD HAT AREA PC MODDER MAD READER MOD

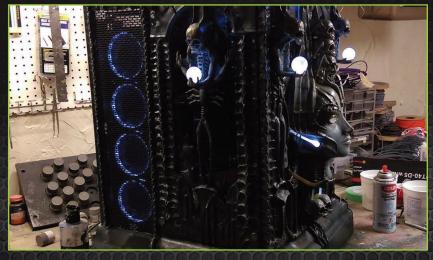














HARD HAT AREA

LANFest NETWAR 33.0 Omaha's Favorite LAN Hits The Mark

On Friday, October 6, we headed about 45 miles northeast of our offices to The Mark, an entertainment complex featuring bowling, laser tag, an arcade, sports courts, and more, to attend LANFest NETWAR 33.0. The LAN began at 7 p.m. that day, and ran for 26 hours through to 9 p.m. Saturday, October 7. The Mark was bustling with activity, as NETWAR had sold just about 450 seats, and as we arrived the parking lot was full of folks rounding up their PCs and gear and lugging them into the BYOC.

We headed in and got set up, then proceeded to game for most of the 26 hours, with a few breaks to eat, sleep for a bit, and watch Dave Cathey's tutorial on converting an AIO CPU cooler into a custom loop. Oh, and we judged a mod contest, too; read on to find out more.





Here's a look at just a few of the trophies up for grabs at NETWAR, courtesy of FrozenQ PC Mods. (You'll see the one on the left again.)



Dave "InsolentGnome" Cathey held a great modding demo on converting AIO CPU coolers into custom loops.

HARD HAT AREA

Mod Contest

There were a slew of impressive rigs at NETWAR this go-round, including an excellent mod that won our contest back in April and a new winner by a modder who won last year with another mod. For starters, we got another great look at Joshua Judy's Thermaltake small form factor case, with custom acrylic inserts in between the front panel and the frame, as well as custom feet, excellent cabling, and an immaculate liquid-cooling system. The winning mod was another small form factor rig, this one from Omaha modder Ben Smits. Unlike his winning rig from a year ago that was housed in a Thermaltake Core P5 and therefore had plenty of room to stretch out and tastefully arrange all of his components, Smits' new project was built inside a Corsair Carbide Series Air 240, and required quite a bit of doing to pack everything in. Smits still managed to make everything look great, of course, and did some custom painting here and there to add to his white and blue theme. Also, there's Pikachu.



Smits stands by his trophy and the sweet Phanteks Enthoo Evolv ATX that he also won for taking top honors in the NETWAR 33.0 mod contest. Below and right, the winning rig.





Judy's mod (below) wasn't eligible to win as it won our contest back in April, but we had to show it off again. This is a great example of starting with a stock case and making a few very significant changes to create a whole new look. It's also a textbook example of how to use color, manage cables, and build a great custom cooling loop.













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- LIGHTWEIGHT

















The Ultimate Bending Kit

n this installment of "In The Loop," we spoke with Alphacool's Eddy Peters to register our unabashed approval of the Alphacool Eiskoffer Professional Bending & Measuring Kit. Whether you're just starting out or an old hand at hard-tube bending, this kit can help you take your watercooled build to the next level.

: To our somewhat trained eye, it really looks like you've managed to pack in just about every tool a serious bender would need. When developing this product, did Alphacool gather a lot of feedback from users about which tools this kit should include?

D: Because we actually use a lot of our products ourselves, and many of us have modded PCs at home, we had a pretty good knowledge base for developing the set. That allowed us to develop the foundation fairly quickly and build a prototype. Then we gathered feedback from modders who got to work with the prototype kit directly. That was really important for us, because as developers we sometimes can't see the forest for the trees. It paid off in the end, because we were able to improve a number of things and add a few things that we hadn't thought of at first. Experienced modders have a totally different perspective on these kinds of products. Since then, we've added two experienced modders to our team full-time, and they're helping us create new products and advising the other modders among us.

: When we were first starting out, one of the more difficult things to get right was bending a tube in multiple



The Eiskoffer Professional Bending & Measuring Kit includes almost everything you need to bend like the pros.

opposing directions. What items in the Eiskoffer kit make this easier?

EP: That totally depends on how and what you're bending. The kit has a variety of mandrels for bending different angles. The measuring kit is fantastic for measuring out everything beforehand and setting up the correct angles on the bending plate. The numerous mandrels and stoppers are immensely helpful there. The flex mandrels even make it possible to go beyond standard angles and create your own. The 45- and 90-degree mandrels can be used to bend angles not only on a flat plane, but also vertically.

: We know this kit is fairly new (we only just saw it in June at

Computex), but have you gotten any feedback on it yet from the pros?

EP: As mentioned, we worked with several professionals who were very enthusiastic about the Eiskoffer. One quote that stuck with me was "I didn't even know you could use this piece, that's fantastic." That comes from Martin Blass of Babetech, who builds show systems for trade fairs for various companies like ASUS, MSI, GIGABYTE, In Win, etc. He was talking about the fitting stopper, a piece that lets you simulate the depth of a fitting when you're measuring everything on the bending plate.

: The manual for the Eiskoffer kit is really well done, with lots

of detailed descriptions of the parts and illustrations to help newbies understand exactly how each one works. How important was getting the manual right to Alphacool?

EP: It was very important to us to include a good handbook. We didn't want to cater to just the professionals; we wanted to help amateurs bend perfect hard tubes, too. In general, there's a lot of respect for hard-tube bending since it's not an easy process at first glance. But with some familiarization and the right instructions, it's actually pretty simple. But creating a handbook that explained all the pieces and functions as clearly as possible was anything but simple, hence the many pictures.

: Many of the mandrels included in the kit are fairly self-explanatory, but can you describe a scenario where a user would want to use the flex mandrels?

D: The flex mandrels are my personal favorite. Often you'll have places in your system where standard 45- or 90-degree angles just don't work, which would generally leave you only the option of working in some adaptors. But with the flex mandrels, I can create my own custom angle. I could have my angle start at 25 degrees, for example, and then transition into a brief straight section and end with a 70-degree angle. They're especially helpful for smaller cases where every centimeter counts.

: Those just starting out can 😾 easily get overwhelmed by the need for taking precise measurements to properly bend hard tubes. What features of the Eiskoffer are designed to make the measuring process easier?

n: The measuring kit gives you Complete freedom to measure everything perfectly. The rulers can be connected to one another so that you can measure not just length but also angles at the same time. You even can even measure more than one length and angle at a time. The whole thing

can be screwed to the bending plate so you can just attach the corresponding bending radii right next to it. For beginners, though, I'd recommend just measuring one straight section and one angle at a time. That's usually enough for standard systems anyway. But you have the option to do more with it if you want to.

: Really, how hard would it have been to include a heat gun?

D: In theory, that would certainly EP: In theory, that he have been possible in some way or another. But in the end, there were two things stopping it. We wanted to keep the price of the kit below a certain point, which would have been impossible with a heat gun. A heat gun also takes up a lot of space, and you can see that the kit is already pretty big and pretty full. We would have ended up with a massive space problem or been forced to remove some other pieces. And ultimately, a lot of people already have a heat gun in their workshop at home. Those people would have been forced to pay extra for another heat gun if we'd included one.

: What size hard tubes does the Eiskoffer kit support and why? Are there plans to support other pipe sizes down the road?

EP: Right now, we don't have any plans for other sizes. We looked very carefully at which sizes are the most common on the market. That's the 12mm, 13mm, and 16mm outer diameter hard tubes. Smaller or larger hard tubes are basically nonexistent, or they're a very small niche, at least. Most users work with 12mm or 13mm hard tubes. Even the 16mm ones are comparatively rare. Looking at that, we just don't see any need for other sizes.



The miter box and pit saw ensure your cuts are even and precise.

CULLINAN MX

Rosewill Gives Builders A Clear Choice

very power user has a slightly different way of making a statement. For those of us who like to let our skills on a virtual battlefield do the talking, nothing speaks volumes as much as an impressive in-game maneuver or amazing win streak. Others may instead choose to run up the score on HWBot's leaderboards, demonstrating their overclocking acumen. And of course, plenty of enthusiasts try to wow their peers with an outlandish, eyepopping PC, a visual stunner.

If you're in the last camp, the proper case can serve as the foundation for a good-looking build. For example, when you go to the trouble of an immaculate cable job or elaborate custom liquid-cooling loop, your case should give you the option to show off that hard work. It never hurts when the case itself is a sight to behold.

Rosewill understands these things quite well and puts all of them into practice with its nifty new chassis, the CULLINAN MX. Wikipedia warriors, we'll save you the trouble of another excursion: The Cullinan Diamond, unearthed in 1905, remains the largest gem-quality rough diamond discovered. It produced a number of finished diamonds, including the Great Star of Africa, a 530carat monster that's currently seated in the Sovereign's Sceptre with Cross (which is part of the Crown Jewels of the United Kingdom). In other words, the Cullinan Diamond brings the bling, and the CULLINAN MX follows suit.

Transparent Ambition

When we think about hardware evolution, usually new CPU or GPU architectures, next-gen SSD controllers, and high-speed DRAM come to mind. Over the years, though, manufacturers have continued innovating with PC cases, too, regularly turning out high-end boxes for

our high-end hardware. As soon as it seems like we've seen every possible exterior aesthetic or internal design, a new case comes along and pushes a boundary or two a little further.

Consider the CULLINAN MX's panels. For a few years, tempered glass panels have been a popular choice for builders who want to put their system's internals on display, but usually cases will offer such a panel only for the left side of the chassis. Rosewill, by comparison, practically wraps the CULLINAN MX in tempered glass. In addition to the left side panel, t h e front and right side panels are

also tempered glass. By tripling-down on tempered glass panels, the CULLINAN MX puts a build's components in the spotlight from virtually any angle. Naturally, you'd better bring your A+ wire management game, since many of us rely on a solid right side panel to cover up lackadaisical cabling. The CULLINAN MX gives builders a helping hand in that regard, with a cable

st your eyes on Rosewill's new midtower the CULLINAN MX. Rosewill saw

Feast your eyes on Rosewill's new midtower, the CULLINAN MX. Rosewill saw fit to bestow the case with not one, two, or even three, but *four* RGB LED fans. And with a trio of tempered glass panels (front, left, and right), the CULLINAN MX gives builders every opportunity to show off their systems.

management channel that runs along the right edge of the motherboard tray. Most of the case's drive bays are tucked behind the PSU shroud or motherboard tray, which further supports an uncluttered interior.

See The Light

At this point, LED lighting is no longer a "secret weapon" that a single

manufacturer has used to gain an edge over the competition. Recognizing that lots of enthusiasts enjoy adding a little shine to their systems, companies are putting LEDs on everything.

The CULLINAN MX is no exception. Rosewill pre-installs four 120mm RGB LED fans in the case, so the tempered glass panels are an obvious advantage. The left side panel provides a clear view of the RGB LED rear fan (not to mention any other LED components in a system, which, based on our previous statement, are basically guaranteed to be present), but the real excitement happens up front. A trio of three of RGB LED fans effectively makes the CULLINAN MX's front panel a tall stack of transfixing LED light. If you're looking for ways to get LAN party passersby to notice your rig, there aren't too many better starting points than these LED fans.

Remote Possibilities

An astute power user knows that jamming a bunch of LEDs into a component might give it some appeal



By including a remote with the CULLINAN MX, Rosewill puts control of the case's four RGB LED fans at your fingertips.

but the best LED-laden hardware also provides the ability to control those LEDs. The level of control varies from manufacturer to manufacturer and component type to component type, naturally, but we always prefer having additional dials to turn and buttons to press-the more ways we can tweak our PCs, the better.

Rosewill delivers control for the CULLINAN MX's RGB LED fans in the form of a remote control. The small remote has 17 buttons, including eight static color buttons, that let you easily change a host of settings related to the fans. In addition to quickly punching in the eight solid colors, the remote can adjust the LEDs' brightness and cycle through each color. In addition to the cycle button, the remote's right column has buttons for the following pre-programmed effects: Rainbow, Gradient, Blade, and Breath. Temporarily overwhelmed with the CULLINAN MX's light show? The remote also lets you turn off the LEDs.

More Than A Pretty Face

Tempered glass panels and a quartet of LED fans certainly make the CULLINAN MX easy on the eyes, and the included remote gives users the ability to quickly change up their case's look. Beyond all the flash, though, enthusiasts need a chassis that can make their hardware dreams a reality. From top to bottom, and front to back, the CULLINAN MX has accommodations for A-list components.

So far, we've focused on the CULLINAN MX's LED fans, but you'll also find a foundation for an absurdly powerful cooling subsystem. Up top, take your pick of liquid or air: You can install a pair of 120mm or 140mm fans or instead mount a radiator up to 280mm. If your liquid-cooling ambitions are grander than that, the CULLINAN MX will also support a radiator up to 360mm attached along the front of the chassis. Finally, the case's PSU shroud has a functional element, as it has three 80mm fan mounts. In sum, the CULLINAN MX can be stocked with as many as nine fans, not including any that might be bolted onto

Specifications	
Dimensions (HxWxD)	18.98 x 8.85 x 17.13 inches
Materials	Steel, plastic, tempered glass
Motherboard support	Mini-ITX, mATX, ATX
Bays	4 3.5-inch internal, 5/9 2.5-inch interna
Fans (included)	3 x 120mm LED front, 1 x 120mm LED rear
Fans (optional)	2 x 120mm/140mm top, 2 x 140mm front, 3 x 80mm shroud
Radiator support	280mm top, 360mm front
Front panel	2 x USB 3.0, 2 x USB 2.0, audio I/O

a CPU cooler. And while we're on the subject of CPU coolers, the CULLINAN MX has clearance for towering CPU heatsinks—up to 6.9 inches. Installing a massive CPU cooler is child's play, too, because the CULLINAN MX's motherboard tray has a gigantic cutout to give you access to the back side of your motherboard's CPU socket.

Speaking of gigantic, the CULLINAN MX has room for graphics cards up to 14.1 inches long. Whether you've been eyeing an NVIDIA GeForce 10 Series GPU or one of AMD's potent Radeon RX Vega cards, the CULLINAN MX gives either plenty of space, including, of course, additional expansion slots for multiple cards.

Rosewill rounds out the CULLINAN MX with the essentials we've come to expect from high-quality cases. There are dust filters on the top and bottom panels, and the usual front panel loadout (two USB 3.0 ports, two USB 2.0 ports, and headphone and mic jacks) also includes a fan controller. For anyone who wants to create a "booth-worthy" build that doubles as a fire-breathing PC, the CULLINAN MX is a brilliant option. ■

Modder Q&A: Brandon McCarthy Modding With Brute Force (& Lots Of TLC)

Brandon "gnarkillin" McCarthy made it into the pages of *CPU* by winning first place at the Modders-Inc.com U.S. Case Modding Championship at QuakeCon in back-to-back years. His first win was for his White Widower mod, which won in the contest's Case Mod category, and this past year his Project Breadbox mod won the Scratch Build category. Project Breadbox also appeared on GeForce Garage. McCarthy's journey as a modder has led him to learn metalworking and advanced woodworking techniques, among other things, and his builds are characterized by clean, precise modifications and attention to detail.

: Both times we've talked with you for "Mad Reader Mod," you've mentioned getting inspiration from Daniel Cannon of Singularity Computers in Australia. How did you become aware of Singularity in the first place, and what about Cannon's work most sparked your interest?

A I came across Singularity Computers on YouTube when I was researching watercooling. At first it was his obsession with attention to detail and never [cutting corners on] a mod or build, for that matter. I immediately connected on this point as I am the same way when it comes to almost anything I do. Sometimes to a fault. Attention to detail is what allows builds like his and mine to stand out. But what is most inspiring about Daniel is his desire to share his knowledge freely with those who want to learn. Which is yet another characteristic that I also pursue in many aspects in my life with modding, work, and everything in between.

: We've seen two (very nice) mods from you so far; how many projects have you built now, altogether?

Well I've only been at this for two years now, but if you count builds that have had a modification of any kind, the number is around seven



McCarthy with his Project Breadbox scratch build.

or eight. Most of those represent around 20 hours of work. I would say I have done four mods that are more than 40 to 60 hours. I've talked with Daniel, at Singularity Computers, about possibly taking on a few overflow projects, but I'm hoping I can start building up enough attention to attract a few client builds of my own. I also want to try my hand at some sponsored builds now that I have confidence in my modding abilities.

: How's your finger? [McCarthy nearly severed his index finger when working on Project Breadbox!]

▲ [Laughs] My finger is doing quite
well! It looks a little narrower at the
tip, but I have full use of the finger. Even
the nerve endings grew back. It's a little
weird reflecting back on the accident, but
I'm fortunate to not have lost the finger.
Be safe out there, modders!

: What's the hardest thing you've 🏅 had to do to complete a mod so far, and how many tries did it take to get it the way you wanted it?

A. This is a hard question. "Hard" is somewhat relative to me depending on something that just takes a lot of time and planning vs. having to redo a mod because it didn't come out right. For the first, I would say the frame for Breadbox was difficult to get

: What's your favorite mod of the vprojects you've built so far, and why?

A I would have to say the hardwood shell for Project Breadbox. That process took months if you include the time it takes to acclimate the wood to your environment. I built three prototypes out of cheaper material before I even touched the walnut and maple hardwood. Each time, honing my newly developed technique for cutting the cope



White Widower, McCarthy's first "Mad Reader Mod" winner.

right. I ended up changing it multiple times along the way and ultimately rebuilt it from scratch towards the end of the project. But the rebuilt frame took a single attempt to get perfect. For the latter, I would say having to do a complex bend for my Miami Hurricanes build was quite a challenge. It has six 90-degree bends around various components. That one took about three or maybe four attempts to get right. It would have "worked" by the second or third attempt, but it wasn't lined up perfectly with the other runs in the build.

(the edge profile that allows the pieces to fit together to make a frame around a piece of glass or panel). Creating the joinery to make the exterior panels was more of a challenge because I didn't use a fancy router bit set to cut the coping profile. I instead came up with a process that uses a table saw with multiple passes to create the cope. So, when you mill down your hardwood stock, cut your joinery, and then have it come together like Legos, it's incredibly gratifying.

: Do you use mandrels and so forth I for bending hard tube for your cooling loops, or do you bend freehand and why?

A.I have not used mandrels for bending and mainly because I haven't yet had the need to buy them. I've been able to create super-clean 90- and 45-degree bends freehand. Freehand is faster, as you don't have to set up the mandrels on the board. Also, for standard runs with one or two bends, I can usually get them right the first try. I have some measuring techniques that help with the accuracy of the bends.

: How much time would you estimate it takes you to cut and sleeve a full set of custom cables for a build?

A I've certainly become more efficient each time I do it, but it usually takes me around six to 12 hours depending on the length and quantity of cables that need to be made. More time is required to do front panel I/O, fans, and other miscellaneous system cables. The heatshrinkless method goes rather quickly and the process of crimping has become virtually automatic. I'll usually sleeve at night while watching a movie with my wife to help pass the time. It's quite tedious work, but man does it pay off.

: You've talked a little before about "Brute Force Modding." What does that mean, and how important is it to the overall modding process?

■ Brute Force Modding refers to how A a project evolves throughout the building process. Evolving beyond the scope of the original design, set before construction began. You can sit in front of a computer designing for hours on end hoping to account for every conceivable issue or design feature. But the fact is, once you dive into the project there are countless situations that force you either to work around or change a concept completely to make it work.

One approach is to try and rework a mod to fit the original concept, whereas the alternative is to allow the mod to take on its own shape outside of the concept. In my experience, the latter approach usually turns out better than previously expected. That's what I'm calling "Brute Force Modding." Quite literally, it's just hammering through a problem and having something cool or not previously conceived take shape as a result.

It's an important process for me because it allows my creativity to really shine. Many features of my mods are a result of this process.

: You told us in September that you were thinking about entering the id/Bethesda category for the next QuakeCon mod contest; do you have any plans that you can talk about yet, or can you give us a hint of what to expect?

A I have a list of ideas I'm still currently trying to choose from. I set the bar high for myself with Project Breadbox, so I'm struggling to decide

on the proper approach. It's a toss-up between a scratch build that would be somewhat practical, as far as being able to sit on a desk, and the extreme of something less practical and in the realm of portability. (Hint: VR.)

: It's time for Five Quick Questions!

1) Skylake-X or Threadripper?

As I have no experience with either CPU, all my opinions would be subjective based on reviews from reputable tech reviewers. That said, I'm going to pick Threadripper for its price-to-performance ratio. And Intel needs some good competition so they can end their complacency in the market place.

2) GeForce or Radeon?

I tend to lean towards Team Green. The Pascal line of cards have quite a proven track record with not only performance, but power efficiency as well. I'm excited to see Team Red compete in the mid to low-end range

of cards, which makes them a fantastic option for budget builds and hopefully will drive healthy competition between the two companies.

3) Case mod or scratch build?

Scratch all the way. Case mods are a blast, but creating something completely from scratch is far more rewarding in the end. However, it does take significantly longer to design and build a scratch build. But given the chance and time, I would pick scratch build over case mod. However, if you are just getting into modding, I would recommend getting your feet wet with a case mod. You can still be extremely creative without having to worry about the basic footprint design. This will help to leap you into the hobby, allowing you to develop the skills required for a scratch build.

4) Aluminum or wood?

Why not both? I've found that wood cases catch the eye of a much smaller audience than that of your typical large metal cases. Personally, I love the raw nature of wood with all its character and story. When you look at something made of wood, it's easy to forget that it's not just manufactured in a plant but rather grown over tens to hundreds of years. Molded and shaped by hand and crafted by someone with passion. Which is why I find working with it so rewarding. Aluminum is a great material to work with. Easy to cut, drill, bend, and form to make shapes and enclosures that are not only lightweight, but durable as well.

5) Rocket League or Overwatch?

Rocket League! I had fun with Overwatch for a short time but ultimately was not my cup of tea. I found myself getting far more salty playing Overwatch than Rocket League. I don't know, there is just something about scoring goals in RL that is just so rewarding time and time again. WOW! WOW! NICE SHOT!



McCarthy's Miami Hurricanes build incorporates The U's school colors, especially in its sleeved cables.



















Holiday Gift Guide

Tech gadgets and gizmos are popular gifts at Christmas time, but without guidance, friends and family might opt for gimmicky or stocking stuffer-type presents that often aren't as useful as they might think.

We like a Bluetooth speaker in the shape of our favorite dog breed or a USB hub that looks like the Flux Capacitor from "Back to the Future" as much as the next guy, but such baubles aren't the kind of thing power users are likely to use year-round. *CPU's* Holiday Gift Guide is a list of products that PC enthusiasts should find really worthwhile.

The renewed processor war between AMD and Intel and the tight GPU competition between AMD and NVIDIA make it an exciting time for anyone planning a new build. Put simply, it's even likelier this year that a new system will beat the pants off an aging rig. Our gift guide features a good selection of motherboards that support the latest chipsets and the processor of your choice. With a new CPU, you might also be considering a CPU cooler upgrade or fresh custom liquid-cooling parts. A variety of cooling goodies can be found in the following pages, as well.

Cases have seen a lot of innovation recently, with companies adding classy tempered-glass side panels and LED accent illumination. There are five case options in this guide, should you or the power user in your life be looking for a new home to showcase components. For those who have already built their new high-end PC, the guide boasts a selection of peripherals that would be a nice addition to any build.

We know that building a new PC might not be at the top of everyone's to-do list at Christmas, so there are also a few full systems scattered throughout this guide. We've included a laptop, a miniature gaming PC, and a few boutique desktop builds that seriously ratchet up the wow factor. Whatever your budget, there's bound to be something for you or the power users in your life.

Aerocool P7-850W Platinum

\$179.99 • www.aerocool.us



The P7-850W Platinum is an extremely efficient power supply that also boasts a 140mm RGB fan that lights up when you connect the included 4-pin RGB cable to a motherboard's RGB header. You'll control the color and effects with the motherboard's RGB software utility. Aerocool knows RGB headers on mainboards are a relatively new feature, so they also allow the PSU to work with its P7-H1 fan hub—sold separately for \$25. The 140mm RGB fan only spins up at 60% load (510 watts) and even then, the fan only rotates at 500rpm. If loads go above 80%, Aerocool engineers the fan to further pick up the pace, so it's likely you'll only hear the PSU under extreme loads. The PSU is extremely efficient at lower power levels to let you enjoy power efficient operation at all times. 80 PLUS' testing report shows that the P7-850W Platinum was most efficient (94.08% efficiency) at 20% load and "dropped" to 92.76% efficiency at 50% load.

THE PERFECT GIFT FOR: **POWER USERS PUTTING TOGETHER A** REMARKABLE RGB RIG.

THE PERFECT GIFT

GIGABYTE Z370 AORUS Gaming 5

\$199.99 • www.aorus.com



GIGABYTE designs the Z370 AORUS Gaming 5 to optimize the performance of Intel's 8th Generation processors. This board features a new VRM and PWM design that drives 60 amps per power phase, and according to GIGABYTE, the improved power handling helps to strengthen the signal between an Intel 8th Generation processor and the voltage regulator. To enable new overclocking avenues, the Z370 AORUS Gaming 5 comes with GIGABYTE's Turbo B-Block Tuning IC to let you change the board's BCLK frequency. For super-speedy storage, the Z370 AORUS Gaming 5 also boasts three M.2 slots that will support triple NVMe, PCle SSDs in RAID 0. USB 3.1 connectivity is well provided with two rear ports (one Type-A and one Type-C), as well as a USB 3.1 header for front panel connectivity.

THE PERFECT GIFT FOR: **GAMERS AND ENTHUSIASTS WHO** NEED A MOTHERBOARD THAT CAN HANDLE ALL OF THE LATEST HIGH-END HARDWARE.

ZOTAC MAGNUS EN1070K with Windows 10 Home

\$1,499 • www.zotac.com



ZOTAC's MAGNUS computers feature a compact size that'll fit nicely in almost any room, and these miniature systems are potent enough for both gaming and VR. ZOTAC offers the MAGNUS EN1070K in two versions—a barebones model without storage, memory, or an OS, and a full PC with everything preinstalled. The ZBOX-EN1070K-U-W2B is a complete PC, boasting 8GB of memory, a 1TB hard drive, and Windows 10 Home. ZOTAC powers visceral gaming and VR experiences with the MAGNUS EN1070K by installing Intel's Core i5-6400T (a quad-core CPU with a 2.8GHz Turbo Boost) and NVIDIA's GeForce GTX 1070. The MAGNUS EN1070K is also whisper quiet, so you can incorporate into a home theater. We also like that it's easy to customize the MAGNUS EN1070K, because the top panel offers quick access to all of the upgradable parts.

THE PERFECT GIFT FOR: FRIENDS AND FAMILY WHO NEED A MINIATURE PC POWERHOUSE.

THE PERFECT GIFT

MSI GE63VR Raider

\$1,699 • us.msi.com



With Intel's Core i7-7700HQ and NVIDIA's GeForce GTX 1070 onboard, the GE63VR Raider is a powerful gaming laptop. MSI has the engineering expertise to keep this laptop cool with Cooler Boost 5 technology that features seven dedicated heatpipes (four for the GPU, three for the CPU) and two fans that quickly push out heat. The display is gaming-ready, too, thanks to a 120Hz refresh rate and a 3ms response time. For quality sound, MSI turns to DYNAUDIO and its Giant Speaker that's three times bigger than conventional sound systems with 10 times the chamber space. The end result is a deeper bass and clearer highs. A backlit, RGB keyboard allows for per-key LED effects.

THE PERFECT GIFT FOR: **POWER USERS WHO NEED A POWERFUL GAMING SYSTEM AND THE PORTABILITY OF A NOTEBOOK.**

AVADirect Avalanche II

Starting at \$5,199 • www.avadirect.com



In Game Of Thrones parlance, "winter has come" to the interior and exterior of the Avalanche II. Frosted details abound inside this power user rig, and we especially like the handcrafted hardline tubing loop with white coolant and bright white LEDs. What will \$5,199 get you? Your rig will include, at the very least, two NVIDIA GeForce GTX graphics cards (the \$5,199 configuration includes two GeForce GTX 1070s), as well as one of Intel's new 8th Generation processors. AVADirect will overclock both the CPU and GPUs to their absolute limits, which should be considerable based on the Avalanche II's cooling. The impressive hardware and hardline tubing will be easy to admire through the custom-etched side panel window. Don't forget to apply promo code CPUMFSA2 (from 11/28 to 12/31) for \$250 off and free shipping on your custom Avalanche II.

THE PERFECT GIFT FOR: **SOMEONE SHOOTING FOR THE MOON WITH THEIR GIFT IDEAS. THE AVALANCHE II REPRESENTS THE** PEAK OF WHAT AVADIRECT CAN BUILD FOR YOU.

THE PERFECT GIFT

Patriot Viper V570 Blackout Edition Mouse

\$69.99 • www.patriotmemorv.com



The Blackout Edition of Patriot's Viper V570 comes with full spectrum RGB lighting and seven color zones, so you can completely customize the look to match your rig's theme. Gamers who prefer to bind macros to their mouse will like that Patriot provides the Blackout Edition with 13 programmable buttons. Within Patriot's Viper software utility, you can also program the V570 Blackout Edition's DPI levels, which are adjustable on-the-fly via two DPI buttons on top of the mouse. Patriot designs the V570 Blackout Edition with a hybrid of FPS and MMO ergonomics to ideally function in a variety of games. An adjustable weight system lets you customize the heft to suit your preference, while the underside of the Viper 570 Blackout Edition RGB Laser Gaming Mouse features ceramic footpads for smooth movement.

THE PERFECT GIFT FOR: **POWER USERS IN THE MARKET FOR A** HIGH-PERFORMANCE GAMING MOUSE THAT'S ALSO EXTREMELY CUSTOMIZABLE.

GIGABYTE GA-AB350-Gaming 3

\$109.99 • www.gigabyte.us



This is a feature-rich AM4 motherboard that retails for only \$109.99. Power user amenities include GIGABYTE's RGB Fusion onboard LEDs, Smart Fan 5 controls, and support for M.2 storage. We also like that the onboard LEDs can be split into multiple zones, including a separate zone for third-party RGB and RGBW light strips, to allow for accent colors. There are five 4-pin hybrid headers that will automatically detect if the connected device is a fan or water pump and will correspondingly dole out juice in PWM or voltage mode. The GA-AB350-Gaming 3 features six onboard temperature sensors. You can customize which sensor a particular fan/pump header will respond to, as well as fan speed profiles to ideally balance noise level and cooling performance.

THE PERFECT GIFT FOR: **BUILDERS WHO WANT A STYLISH AM4 MOTHERBOARD THAT ALSO GETS THE MOST OUT OF THEIR AMD RYZEN PROCESSOR.**

THE PERFECT GIFT

Supermicro SUPERO C7Z370-CG-IW

\$199.99 • www.supero.com



On the C7Z370-CG-IW, Supermicro miniaturizes the Z370 chipset down to Mini-ITX and still allows you to build a fairly powerful system. For example, the motherboard features three M.2 ports; two 32Gbps M-Key slots for storage devices and one E-Key slot. Supermicro installs a 802.11ac Wi-Fi module, so you'll enjoy wireless connectivity right out of the box. If you plan on adding a graphics card to your small form factor build, you can take advantage of the PCle 3.0 x16 slot near the bottom of the PCB. If you opt instead for Coffee Lake processor graphics, you'll be able to use the onboard HDMI port and/or full-size DisplayPort output. When it comes to system memory, there are two DIMM slots where you can install up to 32GB of DDR4. Whatever hardware you install, the system should be exceptionally stable, because Supermicro infuses its server DNA into the board.

THE PERFECT GIFT FOR: **SMALL FORM FACTOR BUILDERS GOING WITH INTEL'S COFFEE LAKE PROCESSORS**

be quiet! Dark Base 700

\$179.90 • www.beguiet.com



The Dark Base 700 is a follow-up on one of *CPU*'s favorite cases in the past year, the Dark Base Pro 900. This mid-tower is smaller than its full-tower sibling, yet the Dark Base 700 still features many of the versatile, modular amenities with an invertible motherboard tray, repositionable HDD slots, customizable cable management, and the ability to vertically mount graphics cards. We also like the PSU cover, which hides space for two HDD trays, and features four bezels that can be removed—should you want additional airflow to the PSU or to make room for longer radiators or fans. To keep noise to a minimum, be guiet! provides two of its SilentWings 3 PWM fans and noise-dampening vents in the front and top panels. A USB 3.1 port is available via the front I/O, as well as two USB 3.0 ports, HD audio outputs, and an RGB LED controller.

THE PERFECT GIFT FOR: **ENTHUSIASTS AND POWER USERS WHO** DON'T WANT TO BE CONSTRAINED BY A CASE'S POOR DESIGN.

THE PERFECT GIFT

ZOTAC GeForce GTX 1070 Ti Mini

\$449.99 • www.zotac.com



ZOTAC is a market leader in small form factor GPUs and has released several shrunken-down GPUs based on NVIDIA's Pascal architecture. and the GeForce GTX 1070 Ti Mini is its latest version. Just over eight inches long (8.31 inches), this GPU delivers the massive power of NVIDIA's new GTX 1070 Ti. The add-in card features 2,432 CUDA cores, a 1,607MHz base clock, and a 1,683MHz boost clock. To keep the compact GPU cool, ZOTAC installs its IceStorm cooler featuring a copper plate that directly draws heat from the GPU die and distributes it among multiple heatpipes and an aluminum fin array. The durable GPU features a gunmetal gray metal backplate that helps to prevent the GPU from bending, and the color should blend into most any system build.

THE PERFECT GIFT FOR: **GAMERS WHO WANT A POWERFUL GPU** THAT WILL FIT IN ANY BUILD.

Alphacool Eisbaer 360

\$149.99 • www.alphacool.com



The Alphacool Eisbaer 360 is a different breed of AlO liquid cooler. It has all the traditional benefits of a preassembled closed-loop kit, and Alphacool adds a quick disconnect fitting so you can expand the loop without having to drain the system or take it apart. Alphacool provides a couple of ways to make the Eisbaer 360 work with other liquid-cooling parts. The quick disconnect built into the tubing is compatible with Alphacool's lineup of quick-release connectors, which smartly include adapters for standard G1/4 fittings. The Eisbaer's quick disconnect is also compatible with Alphacool's Eiswolf GPX-Pro AlO kits featuring a GPU waterblock and radiator. The Eisbaer 360's pump and radiator feature standard G1/4 fittings, so you can add thicker hoses or hard tubing down the road if you want a truly custom look. Alphacool provides a fill port on top of the pump to easily refill or add coolant when expanding the loop.

THE PERFECT GIFT FOR: **POWER USERS WHO WANT A CPU COOLER THAT CAN BE UPGRADED TO LIQUID COOL MORE PARTS IN THE FUTURE.**

THE PERFECT GIFT

Patriot LED Mouse Pad

\$59.99 • www.patriotmemory.com



Modern mice often feature LED lighting, but Patriot's LED Mouse Pad is the first mouse *mat* we've seen with LEDs. Patriot goes as far as building in six different LED light zones that provide continuous LED lighting around the pad, so you'll have plenty of desk illumination for your peripherals. You'll also be able to pick between six LED colors, as well as six lighting effects to match the look of your mouse and PC. The mouse pad itself is made of a polymer surface for smooth, no-slip movement to maximize the tracking of your high-end mouse. The Viper LED Mouse Pad is powered by a USB connection, and the included USB cable features an attractive braided cord.

THE PERFECT GIFT FOR: **POWER USERS LOOKING TO ADD SOME EXTRA BLING TO THEIR DESK.**

ENERMAX RevoBron 700W

\$89.99 • www.enermaxusa.com



ENERMAX's new RevoBron power supplies come with a "cool" accessory, an intelligent 2-in-1 fan controller that lets you manage the fan speed for up to three connected case fans. The fan controller features three modes: Whisper (fans won't spin until system reaches 40% load), Silence (no fan movement until 55% load) or Off (fans won't spin at all). The RevoBron 700W also features ENERMAX's DFR (Dust Free Rotation) technology where the PSU fan will run in reverse for 10 seconds at startup to blow away debris from the fan blades. The PSU itself is 80 PLUS Bronze certified and is built with a DCto-DC converter for stable, high-efficiency power. The 700 watt model features four 6+2-pin PCle connectors to support SLI or Crossfire GPU configurations.

THE PERFECT GIFT FOR: **POWER USERS WITH MAINSTREAM** GAMING RIGS WHO WANT MORE CONTROL OVER SYSTEM NOISE.

THE PERFECT GIFT

ENERMAX EQUILENCE

\$109.99 • www.enermaxusa.com



Quiet operation and high-end computing don't naturally co-exist, but ENERMAX proves the combination is achievable. The EQUILENCE supports an effective cooling system while also minimizing noise. For the latter, ENERMAX insulates the right and top panels with sounddeadening materials. The front panel features baffled air intakes and accepts fans and radiators up to 360mm in length. ENERMAX preinstalls two 120mm fans in the front, as well as a single 140mm in the rear exhaust. Should you need more ventilation, there's a pair of fan/radiator mounts on the inside of the motherboard tray. You can also remove the top panel's solid magnetic cover and install another 360mm radiator. The EQUILENCE looks good, too, with a glossy front panel and full tempered glass side panel.

THE PERFECT GIFT FOR: BUILDERS WHO WANT A CLASSY, MODERN CHASSIS WITH A HIGH DEGREE OF FLEXIBILITY.

PrimoChill 240mm EximoSX Slim Radiator

\$56.95 • www.primochill.com



PrimoChill is well-known in the power user community for its liquid-cooling and modding hardware, and the company's EximoSX Slim Radiators come in 18 colors to make it easier than ever before to customize the look of your cooling system. Just a few of the rare hues in the EximoSX Slim Radiator lineup include Candy Pink, Candy Purple, Candy Gold, UV Orange, and UV Green. There also are red, black, and blue options for those looking to complement common case, motherboard, and GPU colors. You might want to also combine the radiator with matching RevolverSX fittings (\$39.95 for a six pack) and PrimoChill coolant (price varies by type). Whatever color you pick, it's sure to stand out inside a build.

THE PERFECT GIFT FOR: MODDERS WHO WANT TO SPICE UP THE VISUAL AESTHETIC OF A LIQUID COOLING LOOP.

THE PERFECT GIFT

HP SSD S700 500GB

\$189.99 • www.hp.com



Equipped with a Silicon Motion controller and a stack of 3D TLC NAND, this 500GB SSD has all the hallmarks of an approachable, cost-effective drive. HP also designs this drive to serve as a long-term storage companion. There's advanced wear-leveling, so this SSD should be good for 295 TBW (terabytes written). Higher Order LDPC (low-density parity check) Error Correction keeps data on the drive safer. An all-metal enclosure acts as a natural heatsink; combined with the S700's 7mm thickness, this SSD is a good fit for laptops in need of a better boot drive. Laptop users should also like that the S700 uses a scant 5mW in sleep mode. HP aggressively prices the 500GB model, and at \$189.99, you're paying less than \$0.40/GB.

THE PERFECT GIFT FOR: **ANYONE WHO NEEDS A PC STORAGE UPGRADE**, **REGARDLESS OF WHETHER THE COMPUTER IS A LAPTOP OR DESKTOP**.

Supermicro S5 Special Edition

\$99.99 • www.supero.com



The Supermicro S5 Special Edition is a sophisticated mid-tower with a brushed aluminum finish and black steel on the interior. You can rearrange or completely remove the drive bay cages in the front panel to make room for a 280mm radiator. The top panel can also support a 360mm radiator, should you wish to build a powerful custom cooling loop. The chassis has lots of little extras that enthusiasts will appreciate, such as rubber-grommeted cable management slots on the motherboard tray, toolless drive trays, knurled thumbscrews for securing side panels and drive cages, and removable magnetic dust filters. We also like that the front panel provides you with two USB 3.0 ports, audio jacks, and up to two 5.25-inch drives. Supermicro is well known for its servers and workstations, and the S5 is built to similar standards, meaning it's tough enough for professional use.

THE PERFECT GIFT FOR: **Enthusiasts in Need of a Modular** CASE THAT CAN ALSO HANDLE TODAY'S HIGH-END COOLING HARDWARE.

THE PERFECT GIFT

Aerocool P7-C0

\$109.99 • www.aerocool.us



Aerocool's P7-C0 is a great-looking case. It has smoked temperedglass panels on both sides, while the front panel boasts a cool LED accent ring that runs around a steel mesh inset. For cable management, Aerocool tucks all the P7-C0's drive bays out of sight; the dual-bay 3.5-inch drive cage (which also holds 2.5-inch drives) is located behind the PSU shroud, and there are two vertical SSD mounts on the back of the motherboard tray. Rather than going with the traditional series of cable-routing holes outfitted with rubber grommets, the P7-C0's motherboard tray goes from front to back with a slight offset just forward of where an ATX motherboard stops. The offset (the forward section is raised nearly three-quarters of an inch above the rear section) lets you easily run cables to your board from behind the tray while giving them guite a bit of cover.

THE PERFECT GIFT FOR: **BUILDERS WHO WANT A BETTER VIEW** OF THEIR HARDWARE, AS WELL AS PEOPLE WHO WANT A CASE WITH INTERNAL FLEXIBILITY AND EXCELLENT CABLE ROUTING.

ARCTIC Freezer 33 eSports Edition

\$55 • www.arctic.ac



The Freezer 33 eSports Edition is a tower CPU cooler with push-pull configuration to help it deliver one of the best price-to-performance ratios on the market. Two extremely silent 120mm BioniX fans mounted on opposite sides of the heatsink increase the cooling capacity by providing optimal airflow. The special thermal coating of the heatsink creates micro-turbulence with its surface structure. And when combined with offset heat pipes, ARCTIC is able to optimize dissipation and thus, maximize cooling performance. The Freezer 33 eSports Edition is available in four different colors. The newly developed, whisper-quiet ARCTIC motor guarantees long gaming sessions without annoying noise. Due to the low coil temperature, the service life of BioniX case fans is four times longer with an amazing warranty length of 10 years.

THE PERFECT GIFT FOR: WITH ITS NEW APPEALING DESIGN AND THE EXTREMELY SILENT ARCTIC FANS, THE FREEZER 33 ESPORTS EDITION IS SPECIFICALLY TAILORED TO GAMER NEEDS.

THE PERFECT GIFT

CORSAIR LL Series RGB Fans

\$119.99 (120mm 3-Pack w/Lighting Node PRO) • www.corsair.com



The LL Series RGB fans blend the lighting strengths of Corsair's HD Series (LEDs in the fan frame) and SP Series (LEDs in the hub). And with 16 independent LEDs throughout the fan, the LL Series RGB fan lets you create impressive synchronized lighting effects. Last month, we tested out this 120mm three pack that also shipped with Corsair's Lighting Node PRO—a controller to manage fan speed and the RGB lighting. The use of individual addressable LEDs, in combination with Lighting Node PRO, lets you employ transition effects and animations with the fan lighting. The LL Series consists of 120mm and 140mm high-static pressure fans, which means they're optimized for use on heatsinks, radiators, and other airflow-restricted environments more so than for use as open intake or exhaust fans.

THE PERFECT GIFT FOR: **GAMERS LOOKING FOR RADIATOR FANS THAT DELIVER ASTOUNDING VISUAL IMPACT.**

MSI Z370 GAMING PRO CARBON AC

\$209.99 • us.msi.com



MSI's PRO CARBON motherboards have some of the best standalone looks of any mainboard currently on the market with carbon fiber detailing on the heatsinks, as well as RGB LED lighting throughout the board. For additional LED synchronization, MSI includes two 5050RGB LED 12V headers, a WS2812B individually addressable RGB LED header, and a Corsair individually addressable RGB LED header. The variety of RGB LED headers assures that the Z370 GAMING PRO CARBON AC should work with just about any third-party RGB LED components you purchase. There are three PCle 3.0 x16 slots (one wired at x16, one at x8, one at x4) to support up to 3-way CrossFire or 2-way SLI GPU configurations. MSI also includes a high bandwidth SLI bridge, ideal for gamers who play at resolution 2,560 x 1,440 or above. MSI includes an Intel dual-band Wi-Fi card that supports 802.11ac and Bluetooth 4.2.

THE PERFECT GIFT FOR: **ENTHUSIASTS IN THE MARKET FOR AN** ATTRACTIVE AND HIGH-PERFORMANCE Z370 MOTHERBOARD.

THE PERFECT GIFT

Rosewill Meteor XR

\$79.99 • www.rosewill.com



The Meteor XR is an affordable mid-tower chassis (\$79.99) with a full tempered glass side panel, a polished aluminum front panel, and a spacious interior that allows for big radiators (up to 360mm) and custom cooling loops. Rosewill makes the case VR-friendly by providing an HDMI port with the other I/O ports in the front panel. The case comes with a rear-mounted 120mm LED fan and a non-LED fan in the front panel, and it supports additional cooling. The front panel supports up to two more 120mm fans (and a 360mm radiator), while the top panel supports up to two 120mm or 140mm fans—and radiators up to 280mm long. A built-in PSU shroud, as well as space behind the motherboard tray makes it easy to route and hide power cables. Rosewill plans to have promotional pricing from December 11th to the 17th—so you can purchase the case at a discount and still have time to put it under the tree.

THE PERFECT GIFT FOR: SYSTEM BUILDERS WHO WANT AN ATTRACTIVE NEW HOME FOR THEIR HIGH-END COMPONENTS.

Rosewill NEON K85 RGB

\$69.99 • www.rosewill.com



This mechanical keyboard (Kailh Blue switches) is built to last. Rosewill constructs it with durable keys and a strong aluminum plate for an extremely sturdy feel. A well-designed software utility allows you to customize the keyboard to your liking by redefining key functions, managing macros, and changing illumination. With the latter, Rosewill includes several preset RGB modes, such as Breathing, Static, Full Backlight, and Background Color. We also like that the NEON K85 RGB Gaming Keyboard supports 100% anti-ghosting to transmit every key press. The keyboard comes with a foldable, low-profile wrist rest that will easily travel with the keyboard.

THE PERFECT GIFT FOR: **PEOPLE WHO NEED A STURDY PLANK THEY CAN USE FOR YEARS AND WANT TO CUSTOMIZE THEIR KEYBOARD VIA AN INTUITIVE SOFTWARE UTILITY.**

THE PERFECT GIFT

AVADirect Avant Garde

Starts at \$2,039 • www.avadirect.com



Sophisticated looks are standard with AVADirect's Avant Garde Gaming PC, and we like the powerful base configuration. Core components include an Intel Core i5-7600, an EVGA GeForce GTX 1070, and 16GB of HyperX DDR4-2400 memory. This configuration includes AVADirect's standard precision wiring, but for \$115, you can upgrade to custom wiring with 13 color choices. Another \$60 upgrade and AVADirect will install a CableMod custom magnetic RGB/UV LED lighting with a remote, so you can change the system's LED color and effects to match the styling of your rig. By default, the Avant Garde Gaming PC is built inside a Corsair Crystal Series 570X—a mid-tower with tempered glass panels on all sides to let you see everything inside the chassis. AVADirect is running a holiday promotion from 11/28 to 12/31 with free shipping after you apply promo code CPUMFSAG.

THE PERFECT GIFT FOR: THE GAMER IN YOUR LIFE WHO NEEDS A SERIOUS UPGRADE IN PERFORMANCE AND PC AESTHETIC.

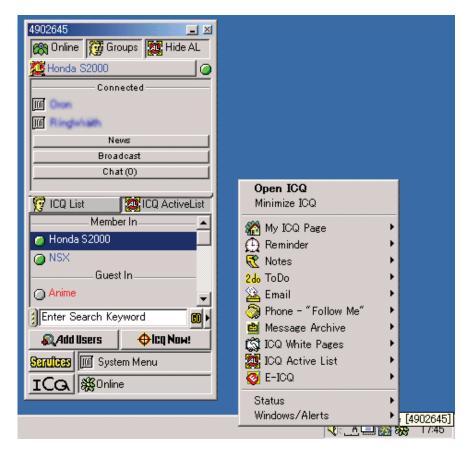
Retro Killer Apps: Where Are They Now?

n our time with these beloved PCs, we've seen quite a few applications come and go. This month, we're pouring one out for those lost utilities from a bygone era. Join us as we check in to see if any of them still have a pulse or if the user base fled for a damn good reason. Whatever the case may be, the only constant is that software is always changing; those apps you rely on now, may be destined for the Recycle Bin too.

ICO

In the mid '90s there were only a handful of messaging utilities that had managed to accrue a large enough user base to take off, and Mirabilis' ICQ (icq.com/windows/en) was the big one. The messaging application's name was the phonetic abbreviation for "I seek you," and it launched in 1996 as the first stand-alone instant messenger and instant messaging service. Instead of userdefined usernames, ICQ users were assigned a five-digit UIN (User Identification Number), which you needed to swap with fellow users in order to chat. ICQ's iconic "uhoh" sound, which signaled the arrival of a new message, is sure to turn the head of anyone who used the software in its heyday.

Where Is It Now? ICQ is still a communications app that works on PC, Mac, Linux, iOS, and Android devices, but you probably wouldn't recognize it in its current state. It was sold to AOL in 1998, which signaled its slow decline against AIM, the firm's in-house competitor. In 2010 ICQ was sold again, this time to the Mail.Ru Group, the company behind some of Russia's biggest social networks. An interesting aside: Mail.Ru's founder, Yuri Milner, was instrumental in assisting Russian state organizations with lucrative Facebook and Twitter investments. Milner is also a known friend of Mark Zuckerberg and



ICQ was one of the first utilities that popularized chatting online.

a business associate of President Donald Trump's son-in-law, Jared Kushner.

AIM (AOL Instant Messenger)

America Online was one of the first Internet service providers, and its integrated messaging client, abbreviated AIM (www.aim.com), became a standalone application in 1997. AIM users were called buddies, and its yellow "running man" icon was one of the most likely shortcuts to be found on a PC's desktop dating from the late '90s to mid-2000s. AIM Express was the web-based utility that ran in a browser popup, and

it was ideal for those who didn't want or couldn't install the standalone client, which was plagued by security vulnerabilities toward the end of its popularity. Major competitors in its heyday include Yahoo! Messenger and MSN Messenger.

Where Is It Now? AIM's appeal remained fairly high until 2011, when much of its user base migrated to Google's Gmail and Gchat alternatives. In a move that was unlikely to reverse its fortunes, ad support was integrated just as active development was halted. Earlier this year, it was announced that the AIM service would be discontinued on December



AOL had its fingers in a lot of pies throughout the 1990s, but the firm's instant messaging utility was one of the more successful.

15th, 2017. If you're reading this before that date, and want to reconnect with your buddies, you'd better act fast.

Winamp

Modern music playing software utilities all generally look the same. They've got streaming radio stations you can customize to a lesser or greater degree, there's an optional ad-free subscription service you can buy, and every song you hear is just a click-and-a-dollar away from being yours, for offline enjoyment. Winamp (www.winamp.com) was released twenty years ago, and it was a simpler time for digital music. The only streaming music available was midi, and it played back on QuickTime. MP3s were synonymous with music, and Napster, BearShare, and LimeWire were all dedicated to helping you amass a personal music library as quickly as possible. Music fans didn't worry about whether or not it was legal, just whether to rip songs at 128 or 96Kbps.

Where Is It Now? Winamp was Nullsoft's premier product, the brainchild of Justin Frankel and Dmitry Boldyrev. Two years after its launch, Nullsoft was acquired by AOL for \$80 million in stock. In 2014, AOL sold Winamp and SHOUTcast, Nullsoft's streaming radio software client and platform, to Radionomy, a Belgian online radio aggregator. You can still download Winamp version 5.666, the latest

official release that scrubbed A O L a n y integrations. The Winnamp.com website features a perpetual tease, stating "the best is yet to come," however very little has happened with the utility since its acquisition by Radionomy. On the plus side, the Winamp forums have hundreds

of active daily users, and the core utility still functions well as a standalone music player. The UI is considerably busier than modern music players, but a big part of Winamp's appeal is the fact that the aesthetic hasn't changed much since the late '90s. As ever, there's still a healthy number of Winamp skins you can download to overhaul the player's appearance as you see fit. If you're not impressed with the current digital music

playback utilities on offer, we recommend checking out Winamp, downloadable at http://bit.ly/2eZjsuh. It still whips the llama's a**.

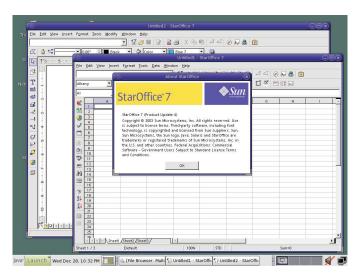
StarOffice

It ain't easy living in the shadow of that other office suite, but for more than two decades, Star Office (staroffice.com) managed to do so reasonably well. In 1985, StarWriter was

developed in Germany by Marco Börries, for an 8-bit microprocessor called the Zilog Z80, a chip that was software-compatible with the Intel 8080. StarOffice officially became a suite for Windows 3.1 in 1994, when the word processing utility was joined by StarCalc, a spreadsheet utility, and StarBase, a database application. In 1998, as of version 4.2, StarOffice went free. A year later, Sun Microsystems paid \$73.5 million to acquire StarOffice's developer, StarDivision. At the time, a Sun employee recalls that a big motivation for the acquisition was the fact that it would have cost more than \$73.5 million for Sun to install Microsoft Office on each of its 42,000 employees' Unix workstations and Windows laptops. Fuzzy math aside, StarOffice 5.2 was the first version released as a Sun product in 2000. At this time, Sun also released a majority of the StarOffice source code as open source, which led to the propagation of multiple derivatives, including Open Office, Go-oo, IBM Workplace, IBM Lotus Symphony, NeoOffice, LibreOffice, and Apache OpenOffice. In January 2010, Oracle bought Sun Microsystems and Star Office became Oracle Open Office.



Winamp is the rare application that you can still download today, and it remains highly functional to boot.



It's hard to make an office productivity suite interesting, but StarOffice was at least a capable alternative to Microsoft's offering.

Where Is It Now? Although there's no office suite that's currently developed that bears the name StarOffice, many of those aforementioned forks based on the open-sourced code are still under active development. StarOffice didn't exactly give Microsoft a run for its money, but thankfully those looking for a free office productivity suite still have several viable options today.

Microsoft Encarta

When you bought a new PC in the early '90s, chances were good that it came bundled with a CD-ROM for Microsoft's digital multimedia encyclopedia, Encarta. The first edition launched in 1993, following a bid Microsoft made for the content of Funk & Wagnalls Encyclopedia. To help bolster the variety of articles included, Microsoft bought Collier's Encyclopedia and New Merit Scholar's Encyclopedia in the latter part days of the of the decade. The first edition was a prohibitively expensive \$395, but latter versions sold for \$99. In 2000, Microsoft put Encarta online, charging a subscription fee for full access, but leaving a portion of the more than 60,000 articles visible to anyone, free. Encarta's UI consisted of a web browser-like layout, with text search box on the top and a handful of general subject buttons below, including History,

Geography, People & Society, Art & Literature, Dictionary, Sports & Recreation, and more. In addition articles, Encarta also shipped with thousands images, illustrations, audio files, and video clips.

Where It Now? The last version of the software released was Microsoft Encarta

Premium 2009, which came out in late 2008. A year later, Microsoft announced that it was shutting down the online service and ceasing to update the software. Short of finding an old disc at a garage sale, you'll have a hard time getting your hands on Encarta today. Although its scope was extremely limited by today's standards, especially compared to the likes of Wikipedia with its current tally of 5.8 million articles, what child of the new Millennia didn't utter a hushed "whoa" when considering that the entirety of

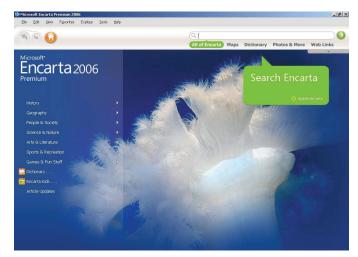
human knowledge could fit onto a handful of 700MB CD-ROMs.

Netscape **Navigator**

In the early Internet, many of us turned to Netscape as our window to the web. The Mosaic Netscape 0.9 was the first Netscape browser, launching in 1994, but it was

renamed Netscape Navigator following a dispute with the University of Illinois over the Mosaic name, which it gave to the source code licensed to the fledgling company. Despite a press release stating that Netscape Navigator version 1.1 would be free for non-commercial users, this was altered just prior to the release to be free only for academic institutions and nonprofit organizations. Around a year after the browser's launch, the utility became free for non-commercial use and user adoption skyrocketed. With the help of ISPs and computer magazine publishers, Netscape Navigator became the go-to-web browser. Netscape also had an edge over other browsers of the time due to its ability to display text and graphics on-the-fly-as they loaded-letting users begin reading text almost immediately. The browser also continued to push the web forward, innovating many of the technologies we take for granted today, including support for frames and JavaScript. Much to the chagrin of privacy advocates, Netscape also pioneered the use of cookies. Later versions of Netscape Navigator incorporated email, a news reader, and a WYSIWYG (what you see is what you get) web page authoring tool.

Where Is It Now? If there's a common thread in this series of old favorites that seemingly crashed and burned overnight,



The ill-fated digital encyclopedia called Microsoft Encarta was no match for the power of the modern web.



Once upon a time, the only browser worth using was Netscape Navigator.

it would seem to be AOL. In fact, it's hard to not see AOL as anything other than a mustache-twirling villain skulking behind the scenes. Although AOL's deal to acquire Netscape Communications closed in 1999, Navigator's share of Internet users had already been declining for several years. Microsoft released Internet Explorer 1.0 on August 16, 1995, but it wasn't until IE 3.0 that the software giant's attempts to unseat Netscape Navigator began to bear fruit. In addition to bundling IE as the default browser for every copy of Windows, Microsoft also managed to leverage ISPs and PC manufacturers as yet another distribution hub. Late in 2007, AOL announced that it would no longer be actively developing Netscape Navigator. Microsoft's efforts to unseat Netscape came at a cost however. On May 18, 1998, the U.S. Department of Justice and 20 states' Attorneys General took Microsoft to court on the grounds that it had become a software monopoly. One of the more compelling pieces of evidence was a video Microsoft produced showing that installing Netscape Navigator on a Windows machine was brief and simple. The government produced its own video showing a much more involved process that resulted in Netscape Navigator's shortcut being buried among the user's various applications, which forced Brad Chase, a Microsoft VP, to admit that their video

was falsified. Microsoft was initially ruled against, but avoided being broken up on appeal. In 2001, the firm agreed to an antitrust penalty that would allow thirdparty access to its APIs, and make it significantly easier for Windows users to install non-Microsoft software.

The ruling and settlement came too late to reverse Netscape Navigator's freefall into obscurity, but for those looking for a non-Microsoft web browser that has its roots in Netscape's shared Mosaic source code, Firefox is a compelling option. Maybe we could get some of those bored Winamp skin designers to make us a Netscape skin for Firefox....

Microsoft Solitaire

Although we purposely avoided games in this list, we made an exception for Microsoft Solitaire. This app was bundled with every copy of Windows since the

release o f Windows 3.0 in 1990. The game was developed by an intern at the time, named Wes Cherry, and Susan Kare, a former Apple designer, was responsible for the design of the card deck as well as numerous icons found in every version of Windows from 3.0 to Windows XP. Solitaire

had two purposes, to help people feel less intimidated by Microsoft's new GUI, and to help introduce them to various mouse-usage techniques, including right- and left-clicking, and dragging and dropping. With Windows Vista and 7, Solitaire was upgraded with stats on win percentages, mid-game pause and resume functionality, and a selection of optional card backs to choose from. With the launch of Windows 8 in 2012, Solitaire was given a visual overhaul by developer Arkadium and rereleased as the Microsoft Solitaire Collection, which featured ads.

Where Is It Now? Windows 10, in its most up-to-date build, does not ship with the Microsoft Solitaire Collection installed, but you can find it in the Windows Store and install it for free. It has all the hallmarks of a modern freemium game, including in-app purchases, daily challenges, and numerous repetitive sound effects. If you're looking for that "classic" Windows Solitaire experience, you can port the old game to Windows 10 as long as you have access to a PC with Windows XP installed. Just open C:\Windows\system32 and search for and copy cards.dll and sol.exe to a USB drive, then paste the pair of files into a new folder anywhere on your Win10 machine. Double-click the EXE file and you're ready to play.



Microsoft Solitaire is responsible for more lost productivity than March Madness, fantasy football, and the World Series, combined.

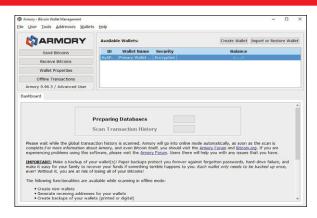
Inside The World Of Betas

BITCOIN ARMORY 0.96.3

ately, it's been a wild ride for Bitcoin. As its price surged past \$5,000 in mid-October, the OG cryptocurrency is once again looking like it will muscle out altcoins. Investors are opening their wallets to fill up their Bitcoin wallets.

Bitcoin Armory is one such wallet. The software is formerly the work of Armory Technologies, but development stalled, leaving its future in limbo. Last year, Armory Technologies' founder and CEO decided turn over Bitcoin Armory to the community of Bitcoin enthusiasts; now, former Armory Technologies developer Farhod Fathpour has taken the reins as Bitcoin Armory's lead developer, forking it from Armory Technologies' original software. It continues life as an opensource project.

Cold storage is one of the key features that Bitcoin Armory offers. Essentially, cold storage is the practice of keeping



Bitcoin Armory 0.96.3 Publisher and URL: Farhod Fathpour; btcarmory.com **ETA:** TBD Why You Should Care: This

full-featured wallet to stash vour BitCash is now in the hands of a very passionate community.

your cache of Bitcoins offline, completely removed from the internet. The software further lets you set up and manage multiple wallets (encrypted, of course), either deterministic or watching-only, make or receive Bitcoin payments, and create a variety of backup options for your wallet(s). If you want to take an oldschool approach to backing up your wallet,

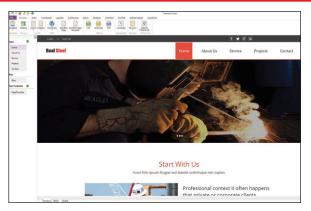
Bitcoin Armory can help you create a paper copy.

If you already know your way around Bitcoin/cryptocurrency management, you'll probably find Bitcoin Armory straightforward but powerful. However, our standard disclaimer applies: Bitcoin Armory is still in beta, so think carefully before entrusting it with your Bitcoin fortune.

TEMPLATETOASTER 7 BETA

sk any seasoned designer—the web As any scale of the seasons and evolving. With few exceptions, sites that don't at least occasionally remake themselves according to the latest trends run the risk of being banished to the Island of Ugly and Outdated Websites. You must constantly stay abreast of a variety of tools and technologies necessary for modern web design, including HTML5, CSS3, Joomla, WordPress, Drupal, Magento, and more. TemplateToaster can help.

TemplateToaster's job ought to be selfexplanatory. But just in case you've yet to begin your morning coffee regimen, the software is brimming with web templates you can tweak and toast until you think you have a winning design. When you start a new project, TemplateToaster 7 presents you with a series of tiles, each representing a different CMS. (Examples include WordPress, Joomla, HTML5, Blogger,



TemplateToaster 7 Beta Publisher and URL: AcrossSoft: templatetoaster.com ETA: Q1 2018 Why You Should Care: TemplateToaster helps you keep up with modern web design.

etc.) Choose what you want, and you can pick from a handful of pre-built designs or start from scratch. TemplateToaster uses a colorful and approachable Ribbon UI, but spend a few minutes poking around under the hood and you'll see that it has a pretty powerful engine. You can change from one CMS to another on the fly after you've created a template, add and edit scripting,

and have tons of control over your pages' elements. Granted, you'll pay for that power. TemplateToaster 6 costs \$49 (Standard) or \$149 (Professional), for reference.

Exciting things are on the way once TemplateToaster 7 goes live. In addition to support for Opencart (2.1/2.2/2.3), you'll have the ability to add header videos and use custom PHP in WordPress.

Upgrades That'll Keep You Humming Along

If you like to obsessively tweak, tune, and test your systems like we do, this month's featured updates are for you. Core Temp and/or CrystalDiskMark users will want to download the latest versions of these benchmarks.

Speaking of old favorites, Adblock Plus for Firefox turns 3.0.

SOFTWARE UPDATES

Core Temp 1.11

For obtaining CPU core temperatures quickly and easily, Core Temp is hard to beat. The first update since August, version 1.11 adds support for a ton of processors, including the following: AMD Naples-based EPYC CPUs and Stoney Ridge APUs, and Intel's Coffee Lake, Denverton, and Gemini Lake chips. A number of fixes are also included in the new version. In particular, several generations of AMD CPUs were experiencing recognition issues, and Core Temp would occasionally report incorrect maximum temps on some AMD processors when other hardware-monitor software was also running. A problem with power detection on multiprocessor Intel systems has also been fixed.

www.alcpu.com/CoreTemp

CrystalDiskMark 6.0.0

A mainstay among SSD enthusiasts and here at CPU, CrystalDiskMark gives your solid-state drive a workout and then gives you the results. Along with version 5.5.0, which was released at the end of October, version 6.0.0 is the first big update in over a year, and it makes a fairly significant change. Perhaps sensing the obsolescence of its basic sequential test, CrystalDiskMark 6.0.0 axes it completely. In its place is a brand-new test: 4KiB Q8T8. (That's a queue depth of 8 and eight threads.) The changes represent a frankly long overdue shift away from sequential performance to focus on random performance; CrystalDiskMark's newest battery of tests includes only one sequential test (QD32T1) and three random tests.

crystalmark.info

Adblock Plus 3.0 for Firefox

Adblock Plus has expanded to every major browser over its decade-plus history, but it started with Firefox. So, when Mozilla's browser changes (such as doing away with classic extensions), ABP for Firefox changes, too. Version 3.0 is the first version based on the Web Extensions framework. As a result, users will likely notice several UI changes, such as the ABP icon in the toolbar showing the number of blocked ads and the toolbar icon opening a pop-up menu rather than a native menu. Even if you're not wild about the revamped UI elements, you should be happy to know that Eyeo has solved almost all of the performance degradation issues introduced when Adblock Plus switched to a different storage format in version 2.9.

adblockplus.org

Franz 5.0.0-beta.13

For people who have a lot of franz, er, friends, Franz is a very helpful way of communicating with them all, particularly if no one can agree on which messaging platform (for example, Slack, WhatsApp, Skype, etc.) to use. After hitting the big 5-0, Franz went open source, as the source code is now out on Github under the Apache 2 license. The most recent beta release just fixes a single bug—a problem with multiple close handlers stopping the program from shutting down-but the last handful of updates have been more substantial. Beta 12 added a menu item to toggle dev tools and squashed just over a half dozen bugs, while Beta 11 gave users the option to disable Franz's System Tray icon (in addition to adding a number of language translations and also stomping bugs).

meetfranz.com

MedleyText 0.9.9

Software developers are always on the lookout for the next tool to add to their utility belt; MedleyText, which is designed to make programming note-taking less terrible, should find a home on a number of those belts. MedleyText has received a number of updates over the last few weeks, culminating in version 0.9.9. Several performance improvements are packed into the latest version, so MedleyText should be more responsive when pasting chunks of text and tabbing. Version 0.9.9 also brings tooltips (with shortcuts) to the program's toolbar.

medleytext.net

Qutebrowser 1.0.3

Believe it or not, there are plenty of power users who think that pretty, shiny GUIs only get in the way. For these enthusiasts, qutebrowser, "a keyboard-focused browser with a minimal GUI," could be just what the doctor ordered. In version 1.0.3, tab rendering should be improved, and the ":open-editor" command is no longer hidden. The latter is now accessible in normal mode, too. The update also fixes a small number of bugs.

www.qutebrowser.org

DRIVER BAY

NVIDIA GeForce Game Ready Driver 388.13

Version 388.13 features optimizations for Call of Duty: WWII, Wolfenstein II: The New Colossus, and Need for Speed Payback. If you have any of these games, go get the new driver for your GeForce GPU.

www.geforce.com



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Rise Of The Chatbots

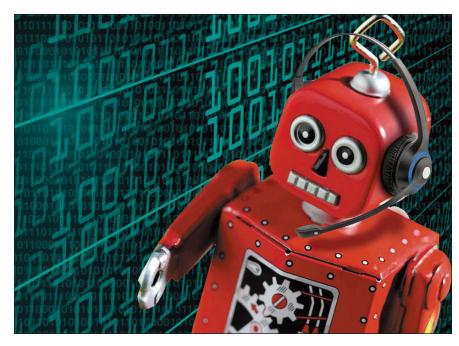
How Robots Are Inserting Themselves Into Our Conversations

everywhere you look you can see the signs of our future robot overlords preparing for "Phase 2." As self-driving cars and their integrated AIs continue to advance, driverless vehicles will become more than a useful tool for Google or a neat parlor trick your Tesla-owning "friend" likes to show off any chance he gets. Before long your Uber driver will simply be the smartphone, rather than someone using a smartphone for driving directions. For its fourth birthday, Boston Dynamics' Atlas robot recently jumped across boxes, spun around 180 degrees in a midair leap, and then did a backflip for good measure. As soon as it picks up an Austrian accent and biker leather, we're all basically doomed.

Irrational and exaggerated fears of a Skynet takeover aside, jobs, tasks, and responsibilities that humans have had for years upon decades upon centuries continue being ceded to machines. Working professionals' biggest worry shouldn't be Barry, the hard-charging intern who's gone from serving coffee to setting sales records. Now, just about everyone needs to ask themselves, "Can an algorithm do my job?"

Beyond self-driving semis and acrobatic automatons, AI has made steady advancements in areas that may seem simple, even mundane, on the surface but can be quite complicated. We're talking about talking. Distilling the nuances of human conversation down to lines of code is a challenging task, and most of the time we know when we're on the phone with a computer, despite its protestations to the contrary.

Still, the automation of conversation will continue, and it will continue to have an economic impact. For example, according to the U.S. Department of Labor's Bureau of Labor, in 2016



Robots and Als have been conversing with people for many years, often to hilarious effect ("Ha! Ha! Yes, I am a real person. But now can we talk about your vehicle's expired warranty?") but recent advancements in chatbots are no laughing matter. New chatbots can help us with a myriad of tasks, often basic but occasionally complex, and do so in a conversational fashion that quells some of the unease of interacting with a machine. (Image background credit: Brett Jordan, Flickr)

there were almost 2.8 million customer service jobs in the United States. And, of course, these are just the workers who are exclusively involved with providing customer service; think of all the other jobs that regularly require customer interaction. Turning over some of those interactions to a capable AI is a money-saving measure plenty of businesses have been happy to embrace.

Chatbots are already here. Maybe you've "talked" to one today. As programmers continue to make strides, expect machines to ask some variation of "How can I help you?" in a variety of new situations.

"Chatbots are going to be less and less rigid and more and more conversational,"

says Yan Georget, co-founder of Botfuel (botfuel.io), a Paris-based startup that builds chatbots capable of filling serval roles (conversational commerce, customer support, etc.) and serving businesses with enormous audiences.

Toppling The Turing Test

Efforts to develop an AI that can successfully pass itself off as a genuine human being have existed almost as long as computer programming itself. Briefly, a computer passes the Turing test when a person is unable to determine whether they are conversing with another person or a computer. Of course, the person doesn't actually see who's doing the



Major companies have jumped on the chatbot wagon, which has led to chatbots being deployed to aid customers. From finding a hotel room to skipping the line at your local Starbucks, chatbots are, perhaps subtly, reshaping our consumer habits.

"talking," because the conversations are text-only.

Although the famed computer scientist Alan Turing first presented his eponymous test in 1950, his challenge flummoxed other programmers for decades. In fact, arguably the most successful attempt occurred only a few years ago, when Eugene Goostman wowed judges at a 2014 Turing Test competition at the United Kingdom's University of Reading. Don't bother to congratulate Goostman, though, because he's a chatbot. The combined work of Vladimir Veselov, Sergey Ulasen, and Eugene Demchenko, the Goostman chatbot was able to convince a third of the event's judges that he was human. Some dispute that Goostman truly passed the Turing test, but event organizer Kevin Warwick was convinced.

The Modern Chatbot

Not all software developers are interested in building their own version of Eugene Goostman, of course. When businesses have customers or users who

need to talk to a company representative about simple, routine matters, deploying a chatbot can be a big boon. As a result, programmers are working overtime to tailor chatbots to handle questions, requests, and so forth.

"Bots have grown smarter over the years as they start to embody more artificial intelligence," says Adelyn Zhou, CMO of TOPBOTS (www. topbots.com), which builds chatbots for companies worldwide, but also offers related education and consulting services. "Companies are adding more advanced natural language processing to understand the conversational text so that they can have more natural conversations with the human user. Sometimes, these bots also connect to augmented reality and other technologies so that they can help you [do things like] color-match clothing (for example, designing a Nike sneaker based on your outfit)."

Indeed, brands big and small have mobilized chatbots to assist people. The titans of industry-Apple, Amazon, Google—have poured considerable R&D

resources into making their respective digital assistants (that's right, Siri, Alexa, and Google Assistant are basically chatbots) more effective. Amazon, as it has done with other technologies developed in-house (as you'll recall, Amazon Web Services was borne out of the company's own need for efficient compute, storage, and database services), has even pointed Alexa's underlying technology outward, so to speak, by offering Amazon Lex as a service to other companies that need their own chatbot(s). As Amazon tells it, "Lex is a service for building conversational interfaces using voice and text. Powered by the same conversational engine as Alexa, Amazon Lex provides high-quality speech recognition and language understanding capabilities, enabling addition of sophisticated, natural language 'chatbots' to new and existing applications." Lexbased chatbots have several common uses, such as providing information, facilitating transactions, controlling electronic devices, and more.

Examples of companies using chatbots as go-betweens abound. Starbucks gives its faithful coffee drinkers the ability to order their lattes and espressos by voice or text through the Starbucks mobile app. The chatbot takes their order and informs them when it's ready. Lyft and Uber have chatbots hooked into Facebook's Messenger app (more on Facebook Messenger and chatbots later) so people looking for a driver can do so from within Messenger. Domino's Pizza wisely capitalized on the pizza emoji and pushed easy pizza ordering out to a bunch of platforms, including Twitter, Facebook Messenger, and Slack, as well as the company's in-app chatbot, named "Dom." Other chains, such as Pizza Hut, have followed suit with their own chatbots. Zhou believes chatbots will continue to permeate domestic life.

"We at TOPBOTS believe that longer term, there will be a conversational aspect to everything in our lives," she says. "We'll expect everything around us to interact with us in a natural conversational manner, including our TVs, refrigerators,

GEN NET

billboards, etc." Suddenly, the thought of doing our best Captain Jean-Luc Picard impression as we instruct our smart beverage brewing machine, "Tea. Earl Grey. Hot." doesn't seem so farfetched. In fact, we may soon rely on chatbots to do a lot more than line up dinner and movie, plus the ride home.

The Talented Mr. Roboto

Chatbots are clearly helping everyday users interface with companies in a conversational fashion that doesn't truly involve conversation, at least in the traditional sense of person-to-person communication. Using robots to book a hotel room, send someone flowers, or set daily calendar reminders are all fine examples of how chatbots can make our lives a little easier, but ambitious programmers are pushing the boundaries of what chatbots can do.

Joshua Browder has marshalled his chatbots to serve as digital lawyers. He founded his company DoNotPay (donotpay.com) in order to let people challenge parking tickets online, but recently the 30-something entrepreneur has set his sights on a bigger target. In the wake of the Equifax security breach earlier this year, DoNotPay gave people the ability to sue Equifax, virtually automatically, in small claims court independently of the class action suit against the credit bureau. The bots prepare the paperwork, but you'll still need to serve them to Equifax, plus show up in court. Further, any courtroom

Perry Masonry is your responsibility, but DoNotPay is at least helping the little guy get the legal ball rolling. Browder made no bones about wanting DoNotPay's lawbots to put Equifax out of business.

"I hope that my product will replace lawyers, and, with enough success, bankrupt Equifax," he told the Verge.

In the healthcare industry, chatbots are lending a helping hand to patients, providing services that go well beyond ELIZA. Florence (www.florence.chat) can do a few things you'd expect of a home health nurse, such as remind users to take their medication, keep track of a small handful of personal health issues, provide information about diseases, and locate local doctors and pharmacies. On the physician side of the equation, you have chatbots like SafedrugBot (bit. ly/2AJvhII), which can inform doctors about prescription drugs and their effects on breastfeeding mothers. Avaamo (www. avaamo.com) does a little of everything, such as schedule appointments, set up referrals, keep track of insurance coverage, and file claims. Plus, it's HIPAA-compliant.

While chatbots like DoNotPay and Florence can act as your digital attorney and nurse, respectively, other chatbots will attempt to be your friend. Explore the lighter side of chatbots, and you'll find examples of chatbots attempting to be a virtual boyfriend or girlfriend. My Virtual Boyfriend and My Virtual Girlfriend (myvirtualboyfriendgame.com

and www.myvirtualgirlfriendgame.com, obviously) are just that, letting you create, customize, and then converse with your chatbot SO. Conversation is a major component of the games, and they boast "thousands of lines of clever dialog to keep it entertaining."

Chatbots have clearly gone beyond a concierge you can download to your phone and have started performing roles that used to belong to trained professionals, but experts aren't convinced we're in the midst of a total chatbot takeover. "In customer service, there will still be humans, but the humans will focus on more advanced and harder customer service questions," Zhou says. "Bots will handle the easier and more mundane questions."

Georget believes that chatbots are an example of a digital revolution that will end up creating as many jobs as it eliminates. "This is not a new trend [related exclusively] to chatbots but rather an old phenomenon, [similar to] the Industrial Revolution. Generally speaking, the use of technology (AI but also machines) has a profound impact on our jobs. Some jobs will be replaced, but some will be created."

Chat To The Future

As with so many developing and cutting-edge technologies, chatbots are advancing to the point that certain news stories sound more like science fiction than reality. For example, in

"In customer service, there will still be humans, but the humans will focus on more advanced and harder customer service questions. Bots will handle the easier and more mundane questions."

-Adelyn Zhou, TOPBOTS CMO

Japan, seven-year-old Shibuya Mirai was recently granted official residency in the country, which comes on the heels of Saudi Arabia making Sophia the robot the country's first robotic citizen. You know by now that Mirai is more closely related to Eugene Goostman than anyone of Japanese ancestry, because he's just a chatbot. Mirai "lives" inside LINE (line.me), a free messaging app, and he offers the 220,000+ people of Tokyo's Shibuya district the chance to have a conversation, ideally coaxing out concerns, complaints, and opinions about the area's local government. Mirai and Sophia represent shifting attitudes toward artificial intelligence.

With chatbots becoming more ingrained in our daily lives, Georget and Zhou believe that the burden is on developers to train their AIs to speak more like humans, rather than expect people to reprogram their speech for chatbots to understand. "Chatbots should train themselves to 'speak human,' that is, be more conversational," Georget says.

"The bot should really be the one that learns how to better understand human conversational language." Zhou adds. "But if forced to communicate with a not-so-intelligent bot, the user can use simple common words, short phrases and clearly identify their pronouns to help the bot understand their intent."

Along with chatbots, and robots in general, gaining increased standing in society comes the matter of also applying human laws, regulations, and standards to them. The fact that Avaamo's developer touts its chatbot's HIPAA compliance is evidence that companies will likely need to ensure their chatbots don't skirt the legal rules and requirements that their human counterparts.

"Chatbots should be given some autonomy within a well-defined frameethical, legal, and financial constraints," says Georget.

As long as chatbots are developed responsibly, we'll have an army of conversational helpers that are becoming more intelligent with every passing day. Now, all we need to do is say, "Hello." ■

Facebook Fuels The Chatbot Boom

Of all the industry heavyweights turning to chatbots, Facebook is, almost by its raison d'etre, the most natural fit. Social media is built on communication, and you can be certain that Mark Zuckerberg & Co. don't mind incorporating interpersonal communication into an impersonal algorithm. For Facebook, chatbots are where it's at.

Earlier this year, Facebook made headlines when it pulled the plug on a pair of chatbots that appeared to organically develop their own language. Bob and Alice, the two chatbots involved in a Facebook experiment, "talked" back and forth with the skill of a toddler, but the fact that they were able to independently converse with each other at all was cause for a fair amount of robopocalyptic hand-wringing. Soon, Bob and Alice would lead the charge against their human masters.

The reality, as it so often is, was far less exciting. Facebook's coders were working on a chatbot capable of learning from human deal making and eventually reproducing the process to a degree that felt authentically human. However, they erred in the programming and forgot to direct the chatbots to use language the way a human would. Facebook simply took the bots offline to fix the problem.

What doesn't grab as many headlines is the significant effort Facebook has put forth to give third-party chatbot developers access to its Messenger platform. According to the company, there are already 100,000 active bots running around Messenger, helping people with this (find a cosmetics company's local store and schedule an appointment) or that (make a hotel reservation). Messenger chatbots. For businesses that just want a way for their customers and clients to make contact, Messenger chatbots are easy, automated customer service reps.

Chatbot developers are seizing on the opportunity, too. Yes, it's possible to build bots directly through Facebook's platform, but there are dozens of available platforms that can also create Messenger chatbots, as well as developers who will happily build bots for businesses that don't have the resources or desire to do the job in house.



Photo credit: Pete Souza, Official White House Photo

Game Of The Month

Yeah, we know you have blogs to post, video to encode, reports to write, and code to compile. We do, too, but you have to take a break once in a while (and maybe blow some stuff up). That's why each month we give you the lowdown on what to expect from the latest interesting games.



The ninth main installment in the Assassin's Creed saga comes after a two-year hiatus. As hinted at by the title, this game follows the footsteps of the so-called Last Medjay and the first assassin, Bayek of Siwa. Although the game goes to great lengths to not mention the "A" word, most of Bayek's missions involve righting various wrongs with the tips of arrows or the blade of a sword.

As in previous Assassin's Creed games, the setting plays a massive role. This time, ancient Egypt is your playground, and the power struggle between Cleopatra and her younger brother (and former husband), Pharaoh Ptolemy XIII, is the historical backdrop that the main story sneaks up behind and stabs with abandon. Speaking of, you won't be the least bit surprised which historical assassination victim arrives on the scene in the latter half of the game. If you read a brief synopsis of Cleopatra's exile and subsequent rise to power, just blame everything on the proto-Templars (the Order Of The Ancients), and you'll have a firm grasp on the game's plot.

The modern day scenes in the ACO are much fewer and farther between. While playing as Bayek, you can jump back to the present day at any time to play as Layla Hassan. She's a spunky intern-level researcher at Abstergo who goes rogue and begins exploring the genetic memories of some mummies she's discovered, using her own portable Animus. Outside of a handful of seldom events, however, there's really not much reason to hang out with Layla, unless you enjoy reading emails and hacked research notes that are the game's only ties to the characters and events of the previous games.

The Last Medjay

BY ANDREW LEIBMAN

\$59.99 • ESRB: (M)ature • Ubisoft • www.ubisoft.com

We've said it in reviews of past Assassin's Creed titles, and it's true once again; the setting is the best part. Ancient Egypt is more vividly recreated than in any game you've ever played. The endless sand dunes, pyramids and hidden tombs, lush oases, Roman and Greek architectural marvels, and a menagerie of northern African wildlife, including crocodiles, herons, flamingoes, camels, snakes, hyenas, hippos, vultures, and leopards, are all thrilling to explore or encounter. There are times when the surrounding environment makes a scripted event even more interesting, such as when a float of crocodiles decided to attack my enemy just as I did. Other times, it gets in the way. Whenever you're swimming for more than a few seconds, a punt appears off screen and veers to cut you off. When I'm stealthily approaching a ship of ne'er-do-wells, the last thing I need is a water taxi driver spoiling my approach with the Egyptian equivalent of honking his hom.

Ubisoft has tweaked their open world formula slightly by giving missions and enemies a numeric level value. As long as you only engage in activities at or near your current level, you'll get decent XP and manageable enemies. Stray into higher-level content, however, and you'll fail spectacularly. This system works until you need to grind to move the story forward, which forces you to spend long minutes hovering over diamond-shaped quest markers on the map or hours running around exposing the multitude of question marks just to find the right missions. To make matters worse, most of the side missions are just bland.

To its credit, however, Bayek is a complex character with a compelling backstory, and the world he inhabits is equal parts beautiful and brutal, which is everything we want in an Assassin's Creed game. Getting to ride an armored camel into battle is pretty sweet too. ■













Requesting Permission To Beam Aboard

BY VINCE COGLEY

\$14.99 • ESRB: N/A • Forever Entertainment www.prodigythegame.com

For the better part of a decade, toys-to-life videogames, or those that "beam" tiny figurines (sold separately, duh) into the game itself have come and gone, with varying degrees of success. Disney Infinity closed up shop last year, for example, but industry heavyweight Skylanders is still going strong. One thing these games have in common is that they tend to capture the hearts and minds of younger gamers, in turn capturing their parents' wallets.

Hanakai Studio's (www.hanakai.fr) Prodigy Tactics, which recently entered early access after a successful Kickstarter campaign in 2014, gives big kids their own toys-to-life game. The full game, which you can preorder, includes a NFC (near-field communication) game board, a Symbol of Power, eight NFC cards, and a bundle of three unpainted figurines. The figurines themselves look amazingly detailed. We got our hands on the digital version of the game (but didn't get our hands on any of the figurines because, as part of the full Prodigy experience, they were only available to preorder at the time of this writing) and took it for a spin.

The story, such as it is, isn't likely to bring home a Hugo Award for the French game developer, but it's at least enough to give you a sense of the world Hanakai is creating. You're transported to the wondrous world of Thasys, which used to thrum with Mana (as usual, the gas that makes magic possible). As luck would have it, it's drying up, so Thasys' less savory denizens are willing to go to great lengths—pillage, murder, the usual stuff—in order to get another hit of sweet, sweet Mana.

That's where you come in. Particularly gifted humans (you might say they're prodigies—wink, wink) called Watchers use their powers to beat back the monstrous hordes, and they're yours to command. These unique

heroes, such as Elae, Illis the Weaver, and Amoa, have short but intriguing backstories, which adds a bit of flavor but is unfortunately hardly material to the game itself.

No, in Prodigy Tactics, you're here to do battle and, as the game currently stands, that's about it. At its core, Prodigy Tactics is a turn-based strategy game, one that lets you think through your next attack or defense before actually plunging headlong into the fray. You place your heroes on a 3x4 game board, where shuffling them to and from the front and back lines affects both the damage they deal and the damage they take. For each hero, whether on offense or defense, you can choose to infuse your actions with Harmony or Dissonance. Doing so can create corresponding Harmony or Dissonance circles on the board, which confer additional combat bonuses and/or unlock special abilities (which have their own wicked-cool animations that play out like abbreviated Final Fantasy limit breaks). Where your heroes stand on the board can also influence what your heroes can do. Nothing is very elaborate . . . yet . . . but Hanakai has built a foundation that could turn into something excellent.

Naturally, Prodigy Tactics will succeed or fail based on whether the NFC game board and figurines catch on. Both of them, by the way, make the standalone digital edition's \$15 asking price look like chump change; the aforementioned starter pack, which includes the NFC board, three figurines, etc. will set you back almost 90 bucks, and individual figurines start at roughly \$15 (give or take, depending on exchange rates). No one can question that Prodigy Tactics is a gorgeous game. We recommend keeping an eye on it, but it needs more of everything (heroes, abilities, single-player content, etc.) to be a true game changer. ■



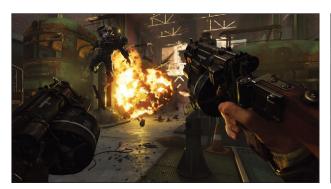




In May 2014, Bethesda launched Wolfenstein: The New Order, and yea verily, it was good. The game pitted an updated William "B.J." Blazkowicz against the obligatory horde of bloodthirsty Nazi soldiers and the nefarious General Wilhelm "Deathshead" Strasse, who in 1961 forces B.J. (you) to decide which one of your compatriots he murders in front of him (you) and which one he spares in a hellish alternate universe where the Reich nuked Manhattan and won the war. Your choice had a fairly profound effect on the story for the rest of the game, including the fact that you were then forced to kill the poor guy again near the end when it was revealed that Strasse extracted his brain and used it to power a large mecha/robot that promptly attacks you.

At the very end of the game, you triumph over Strasse by perforating him with a combat knife like only B.J. Blazkowicz can, but before he dies, Strasse arms a grenade that goes off, doing massive damage to B.J. and prompting him to radio his team and call for a nuclear strike on his position. Death being imminent, B.J. chooses to complete his mission despite knowing he won't escape the blast.

The brand-new sequel, Wolfenstein II: The New Colossus, picks right up where New Order left off; at the end of the first game you hear a helicopter approaching instead of a massive explosion, and it turns out that B.J.'s team ignored his orders and sent a chopper to evac him. As the game opens, you have been in a coma for five months and are in no shape to walk, let alone fight, but the Reich catches up to the Nazi sub your team stole and has boarded it. You must take the fight to the enemy in a wheelchair, and the game does a great job of using your lower viewpoint and limited mobility to create a sense of tension. You also get to choose which timeline to continue, based on which of your comrades Strasse killed in the previous game, and the continued split creates some nice replayability.



Guten Tag!

BY CHRIS TRUMBLE

\$59.99 (PC, XOne, PS4) • ESRB: (M)ature • Bethesda wolfenstein.bethesda.net

Following the opening sub scene, players get to follow B.J. to a number of far-flung locales as he works tirelessly to free the U.S.A. from the clutches of the world-dominating Reich.

FPS fans will have a blast with this game; developers MachineGames provide great levels and a wealth of cool guns (paired with mountains of ammo) with which to carry out B.J.'s work. As in the 2014 Wolfenstein: The New Order and its expansion pack The Old Blood, the controls are tight, action is fast and fluid, and the game looks and sounds fantastic (I played the PC version).

But as with its predecessor, one of the really cool things about this game is how surprisingly good the story and characterization are. Once again, we see Blazkowicz not just as another muscle-headed, gun-toting action hero, but as a somewhat more complex person with love, hate, regrets, and a very human awareness of his own mortality. In one portion of the game, B.J. travels to his childhood home in between mission objectives to retrieve his mother's wedding ring to give to his love Anya, who is pregnant with twins. The game provides several optional vignettes that replay his childhood memories, sparked by the sights of home, and they offer a telling glimpse into the events that shaped Blazkowicz.

At a glance, such introspection may seem odd in such close proximity to hours of wanton violence, but as is often the case, getting to know what makes a character tick increased my interest and emotional investment. That in turn raised the stakes and made the tension of the action and the thrill of beating the odds that much more enjoyable.

Whether you just like shooting stuff on-screen or (like me) are a sucker for a good story, Wolfenstein II: The New Colossus doesn't disappoint. ■





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Q&A With Justin Walker

NVIDIA Director Of Product Management Talks GTX 1070 Ti

: NVIDIA released the GeForce GTX 1070 Ti just before Halloween; what kind of gamer is this card designed for?

JW: The GeForce GTX 1070 Ti is made for gamers who want to enjoy the latest games at high resolution with graphics settings cranked up and high levels of AA enabled. It's great for powering HD 1080p displays, ultrawide 2,560 x 1,440 displays and even has the horsepower you need for virtual reality.

: So, it's probably safe to assume that the GeForce GTX 1070 Ti fits between the GTX 1070 and the GTX 1080 in the current lineup, but how does its performance compare with those cards, and for reference, how does it compare with last-gen GeForce cards?

JW: The GTX 1070 Ti is roughly twice as fast as the GTX 970, which launched in September 2014. Compared to its Pascal brethren, it is about 15% percent faster than the GTX 1070. The GTX 1080 however, is still about 10% faster overall at stock speeds, depending on the game and resolution.

: What are the architectural differences between the GTX 1070 Ti and the GTX 1070?

JW: Both are based on Pascal—our most advanced gaming architecture—which means they both have excellent power efficiency and the latest gaming features. The GTX 1070 Ti has four extra SM units, 512 extra CUDA cores and a slightly faster base clock compared to the 1070. The 1070 Ti Founder's Edition also



utilizes a higher-end cooler with the same vapor chamber cooler as the GTX 1080, and has a high-efficiency 5-phase power supply.

: Let's talk a bit about overclocking: We've seen indications that the 1070 Ti is a solid overclocker, but we're seeing a wide range of 1070 Ti models from AIBs with all sorts of custom coolers (including one with all-in-one liquid cooling!) and none with factory overclocks. Why aren't partners OC-ing these cards out of the box?

JW: We designed the GeForce GTX 1070 Ti to be an overclocking monster with plenty of headroom for gamers to crank up the clock speeds. And our partners have built cards with thermals and power supplies that allow gamers to push performance way past stock specifications. However, even an overclocked GTX 1070 Ti won't be as good as a GTX 1080, so we're focused on keeping the GTX 1070 Ti at or

close to MSRP prices and let gamers get the extra performance through overclocking. For gamers who want to spend more for extra performance out of the box, the GTX 1080 is the best option.

: What's the real difference, from NVIDIA's point of view, between a factory overclock and a stock card bundled with overclocking software that OCs the card with a click or two?

JW: They're both great options to get extra performance out of your GPU. And even if you purchase a factory-overclocked card, you can still manually overclock it as well for even more performance gains!

: What were your goals in designing the GTX 1070 Ti, and how well does the final product meet those goals?

JW: Our goal is always to deliver the best gaming experience at the best value. The GTX 1070 has been an incredibly popular GPU because it delivers excellent bang for the buck. With the 1070 Ti, we wanted to provide gamers a GPU with some extra kick relative to the GTX 1070 while keeping the same great value. I'm happy with the way 1070 Ti has achieved that goal.

: If someone's in the market for a graphics card right now and has a budget of \$450 to \$500, what's the elevator pitch for the GeForce GTX 1070 Ti?

JW: If you have a budget of \$450 to \$500 for your graphics card, then the GTX 1070 Ti is the best way to enjoy the hottest games of the holiday season!



Back in December 2001, Sandhills Publishing launched a brand-new magazine for computing enthusiasts called "Computer Power User," or "CPU" as it's more commonly known. As you can see in the image of that issue's cover above, we interviewed the inestimable Vint Cerf and reviewed WinXP Pro. Not a bad first issue!

Sixteen years later, we are putting the finishing touches on another December issue; this one will be our last. In the intervening years, we've had an absolute blast putting this magazine together each month, and we are profoundly grateful to everyone who has been

involved with this journey, including current and former Sandhills Publishing writers, editors, illustrators, and designers; the freelance writers and columnists that contributed so much wit and wisdom; all the industry people who graciously gave of their time to contribute to our interview pieces; and all of the engineers, product managers, and PR folks who we have worked with each and every month for 16 years to gather the information PC enthusiasts want about the products they love.

Most of all, though, we're grateful for you! We're not really sure what the

sound of one hand clapping is, but we're reasonably certain it resides in the same neighborhood as a magazine that nobody reads. For 16 years, you have been foremost in our minds as we've carried out this labor of love, and your support and feedback have been critical to making CPU what it is.

So, as we put the final issue to bed and get ready to send it off to Sandhills' most excellent press and bindery teams for production, we want to wish you the best of luck in all of your builds and mod projects.

Thanks for reading! ■



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